THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXXI. No. 784.] LONDON, MAY 21, 1878. [30TH YEAR.] Price 6d.

COMPLETION of the FIRST VOLUME OF

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ON THE

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OF THE

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[*For detailed announcement, see page* 810.]

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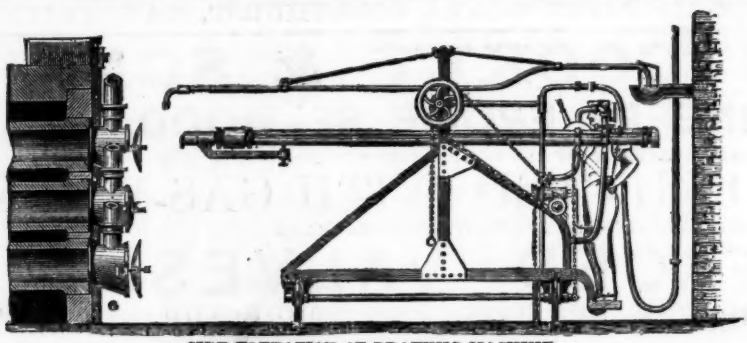
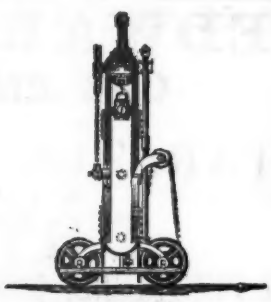


SIDE ELEVATION OF DRAWING MACHINE.



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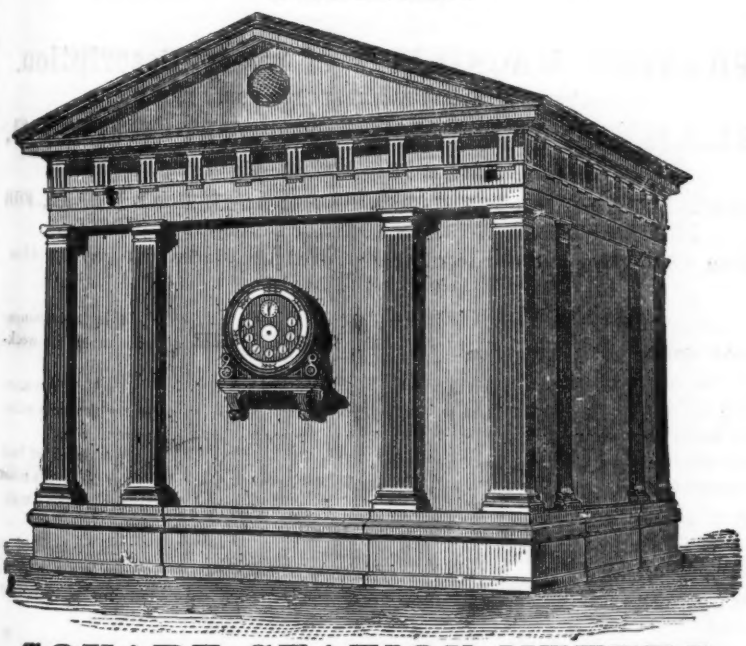

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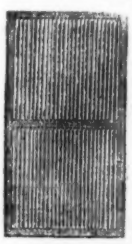

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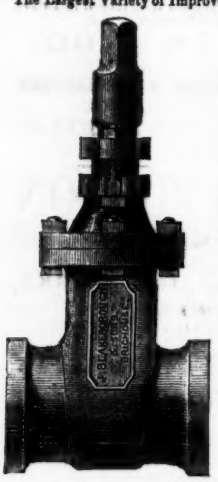

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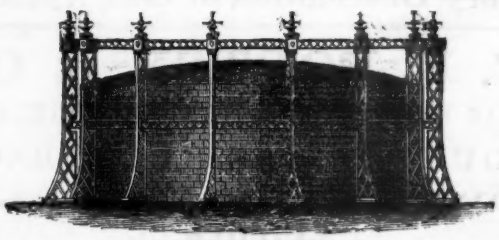

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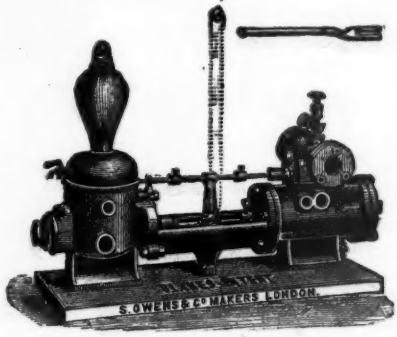
It is economical. Has a lead on the slide-valve.
It is compact and durable.



S. OWENS & CO MAKERS LONDON.

It is interchangeable in all its working parts.
It will deliver more water than any other pump.
It is made of best materials in the most workmanlike manner.
Can be worked at 20 strokes per hour, or 200 strokes per minute.

This Illustration represents Boiler-Feed Pumps, Sizes Nos. 1, 2, and 3, with Hand Lever for working Pump when Steam is not available.

SOLE MANUFACTURERS OF
MANN & OWENS
IMPROVED PATENT GAS-VALVES.
PRICED LISTS AND FULL PARTICULARS FURNISHED ON APPLICATION.

TANGYE BROTHERS AND HOLMAN,

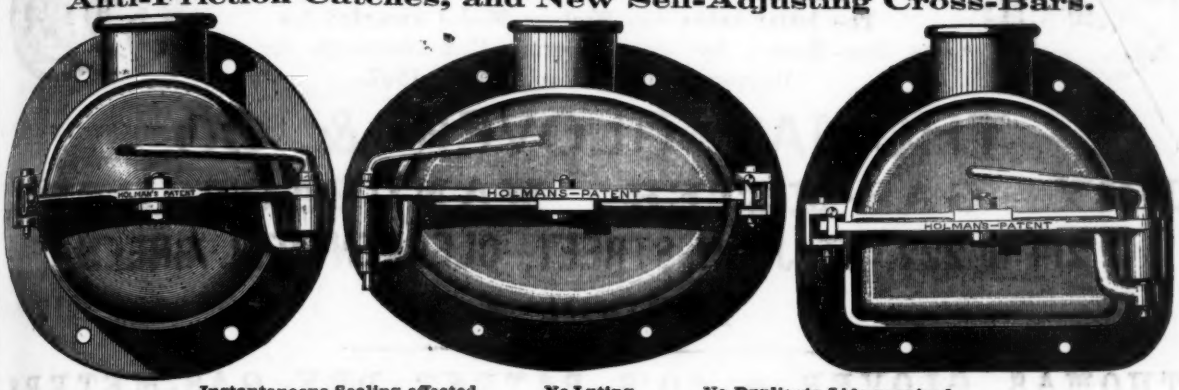
CORNWALL HOUSE, 35, VICTORIA ST., LONDON, E.C.

(LATE OF 10, LAURENCE POUNTNEY LANE.)

SOLE MAKERS OF MORTON'S PATENT SELF-SEALING RETORT-LIDS.

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS,

Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required.

Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested, being now in use in nearly all the principal Gas-Works in London and the Provinces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

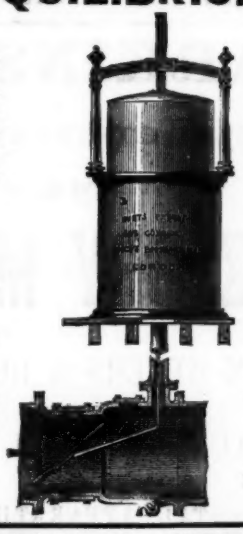
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1878.

MESSRS. TANGYE BROTHERS AND HOLMAN.

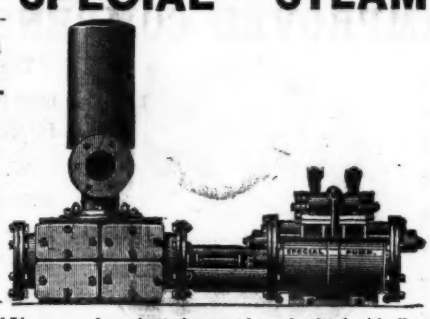
Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,
(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have over FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

FULL PARTICULARS, ESTIMATES, CATALOGUES, ETC., ON APPLICATION.

London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

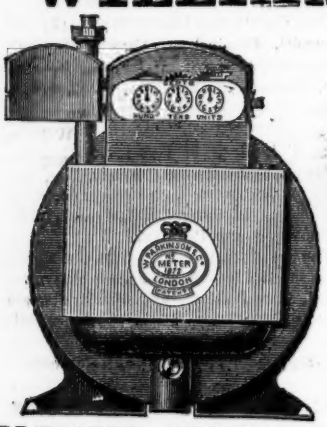
214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON AND CO.,



(ESTABLISHED 1816,)

MANUFACTURERS OF

WET & DRY METERS,

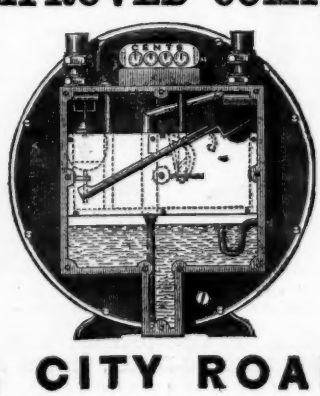
STATION-METERS & GOVERNORS,

EXHAUSTER REGULATORS,

PRESSURE REGISTERS, EXPERIMENTAL APPARATUS, GAUGES, WATER-METERS, &c.

HUNT'S PATENT IMPROVED COMPENSATING METER.

In this Meter, the action of the measuring-drum is reversed. By this arrangement an improvement is effected in the registration at high speeds, which, in many tests, has not varied from the smallest light to three times the capacity of the meter. It works equally well under all pressures. The range of error between the high and low line is much smaller than that allowed by the "Sale of Gas Act."



The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 21, 1878.

Circular to Gas Companies.

We have had some experience of "Regulations" Bills in this country; but our American brethren—the Gas Companies in New York State—are just now exposed to an infliction of the sort, with which we in this country have had nothing to compare. A Bill has been introduced into the State Legislature, which, in the first place, proposes to fix the price of gas according to the population of the district in which the Company exist. There is some reason in this, which is recognized here; for a sparsely populated district cannot possibly be supplied so cheaply as one densely inhabited. But there are other things, besides the density of population, which govern the cost of gas, and must necessarily interfere with the price. We are not informed what differential rates the Bill proposes to inflict on Companies who supply a population of, say, 10,000 or 100,000. We may, however, in broad terms, admit that, all other things being equal, the latter number should be supplied with gas cheaper than the former. The Bill introduces a startling novelty in the standard for estimating the illuminating power of the gas. It proposes to enact that gas of *sixteen-candle* power shall be furnished; but the standard candle is to burn at the rate of 132 grains per hour. Thus the gas must really have the illuminating power of, at least, eighteen candles, estimated by our standard candle burning 120 grains per hour. Why this number has been chosen—unless it be to plunder the Gas Companies—we do not know. Of course, a candle may be contrived to burn, as near as possible, 132 grains per hour; but there can be no substantial reason for varying a standard which is now common to all parts of the world. The most extraordinary part of the Bill is, perhaps, the section which proposes that consumers shall not be compelled to pay for gas supplied to them below the standard quality, and that the Company shall be mulcted in a fine of one hundred dollars for every default, which fine is to go to the informer. We believe the arrangements for testing gas in New York City are very good; but the "informer," in some of the smaller towns in the State, might be a very troublesome character. The wonder is that a Bill of this absurd and monstrous character should, even in the Legislature of New York, have passed to a third reading; that it will become law, we cannot believe. Such an Act, if fully carried out, would of necessity shut up every gas-works in the State; but the probabilities are that the threatened legislation is only intended as a means of extorting money from the Gas Companies. Some dollars and cents will probably square the whole business, and the trading politicians will go home perfectly satisfied with having done their duty—to themselves.

Complaints are made of a nuisance produced at the gas-works of the old Ratcliff Company. Long experience has taught us that these complaints are almost invariably exaggerations. That a smell which some people dislike is produced, we shall not dispute; but that this is at all disgusting, or in any way prejudicial to health, we emphatically deny. An attempt has been made to induce the Metropolitan Board of Works to prosecute the Company for a nuisance; but the Board acknowledge that it is not their duty to take proceedings. If the Vestry of St. George's-in-the-East choose to do so, they must take the risk. It seems perfectly clear that the nuisance, if any, is but slight, and the cause of it already in the course of removal.

That very singular body, the Select Vestry of Richmond (Surrey), have been, as they suppose, making an experiment with the average meter system. They placed meters in the proportion of one to sixty-three lamps, and seem astonished when they are told that meters fixed in this proportion cannot be depended upon to furnish a reliable average. One to twelve lamps is ordinarily employed; but one to twenty has sometimes been used. The latter, however, is, in our opinion, too large a number, except under particular circumstances. The Richmond Vestry object to spend more money on meters, and have referred the question of the adoption of the average system to the consideration of a Committee. They may be perfectly content with the supply as furnished by the Company, certain that, if one lamp burn less gas than is contracted for, at least two others are consuming a great deal more. We have not the smallest objection to Vestries exercising the utmost economy they can in the consumption of gas in the public lamps, but we cannot allow this economy to be practised at the expense of Gas Companies.

With the consent of the ratepayers, Local Authorities may economize as much as they please when they themselves are the purveyors of Gas. The Corporation of Birmingham are, for instance, economizing, and the Watch Committee of that town save £1000 a year by extinguishing the street-lamps at two o'clock in the morning; but various evil results follow. Mr. William Sykes is abroad, and burglaries are not unfrequent. Strange to say, the police sergeants are unable to find the constables in the darkness—a fact at which we, with our knowledge of London streets, in a tolerably full light, are not at all astonished. These foolish economies only bring ridicule and disgrace upon the Lighting Authorities. That a large quantity of gas is needlessly consumed in the early hours of summer mornings we willingly admit, but paltry savings like that attempted in Birmingham only bring contempt on the Local Authority. In winter, the working man who has to start for his shop before daybreak needs gas to light his way, and to deprive him of its help entails a serious inconvenience.

We have before referred to the gas accounts of the Corporation of Rochdale, which, as we have said, show very favourable results from the past year's working. That the revenue should have been reduced is not surprising when we consider the reduction in the price made in 1877. It is, however, gratifying to notice the decrease in the working expenses recorded, as compared with the previous year. Thus we find that in 1876 the wages of stokers amounted to £3819, while last year the sum of only £3158 was expended under this head. The result may, perhaps, be ascribed in part to the use of Foulis's hydraulic stoker. The cost of purification was also reduced from £1062 to £525—a very satisfactory result, if the gas was as well purified as in the previous year. Last week we remarked on the amount of profit, and wondered how it was to be applied. True, it amounts to but five per cent. upon the present estimated capital; but even this is too much.

It seems to have been resolved by the Brighton Town Council that the Gas Companies within their limits are effete undertakings, and, therefore, they will make no attempt to purchase them. The grapes were beyond the fox's reach, and, therefore, Reynard decided that they were sour. The idea of resuscitating

the old Aldrington undertaking, and by this means enabling the Corporation to compete with the existing Companies, is quite worthy of a Town Councillor, who would see with satisfaction the streets torn up in every direction to gratify his favourite whim. The scheme, however, could not be revived without the sanction of Parliament, and the Legislature never allows Local Authorities to compete with Companies. Councillor Savage is perfectly right when he recommends his brother Councillors to take notice of the electric light, and advises them to abstain from gas manufacture. The worthy Councillor is a far-seeing chemist, who, no doubt, knows all about it. The Corporation had better at once make an experiment by illuminating the dome of the Pavilion with the electric light. They may thus acquire a knowledge of the relative cost of electricity and gas.

The Town Council of Winchester, contrary, we are certain, to the wishes of the inhabitants, have decided on lighting the city with oil for another year. The Gas Company refuse to contract for a shorter period than three years, and the Town Council decline to make an agreement for a longer term than one year. We may suppose that the Council expect gas to become cheaper and cheaper every year, and for that reason abstain from making a long contract. There is besides the bugbear of the electric light, which all enemies of Gas Companies affect to believe in. The Companies, however, are not so easily frightened. They can regard the advent of the electric light with perfect equanimity, and are, of course, not disconcerted by the appearance of sooty oil-lamps. The Winchester Gas Company made a really liberal offer; but its acceptance would have involved an expenditure on the part of the Council to undo some of the work which they had done. This was too bitter a pill for the majority of the Council to swallow. So the ratepayers are forced, by their obstinate representatives, to submit to the half-relieved darkness, against which they have almost unanimously protested.

The Local Government Board have sanctioned the borrowing of £71,000 by the Corporation of Stafford, to purchase the undertaking of the Stafford Gas Company. The Shareholders will, therefore, be paid off at once, and the Company dissolved.

The auction clauses are being applied by Mr. Raikes's Committee in what we might call a somewhat capricious manner. The York United Gas Company, whose Bill proposes to limit the dividend on new capital to five per cent., have escaped these clauses altogether. The Radcliffe and Pilkington Company, whose wish was to raise £120,000 entitled to seven per cent. dividend, have the auction clauses applied in respect of £80,000 of the new capital, while £40,000 remains to be distributed amongst the existing Shareholders. The reasons the Committee give for this are, that the Company supply a sparsely-populated district of large area, extensively undermined, which occasions a considerable loss from leakage. It seems also that the dividends of the Company have been but small, and at all times uncertain. It may be that in this case under the operation of the auction clauses, the present holders will be able to obtain new shares at something less than par, unless outsiders are willing to pay a high price for low and irregular profits.

At Shrewsbury, the Shareholders of the Gas Company were recently called upon to decide whether a portion of the new capital authorized by their Act, just passed, should be offered to the public by auction or tender. It was decided to put them up to auction, which, perhaps, is the best way of getting the longest price.

We commence to-day our report of the recent meeting of the West of Scotland Association of Gas Managers, and publish in the present number a useful and suggestive Address by the President, Mr. M'Gilchrist. He brings forward two or three practical points. There is, for instance, a question of the desirability of keeping in the gas the vapours of naphthas, which, condensed into liquids, flow into the tar-well, for the advantage of the tar distiller. There could be no question that the idea which is prevalent at the present time—viz., that of separating the tar from the crude gas at as high a temperature as possible—will, if carried into practice, assist in keeping the naphthas in solution in the gas; but, then, it must be remembered that gas carrying a large quantity of naphtha vapours will not stand much scrubbing without a decided loss of illuminating power. Some means must, therefore, be used for removing as much ammonia as possible before the scrubber is reached. It is not for us to pick out a process, from the many before the profession which promise to accomplish the desired end. Mr. M'Gilchrist seems to think that the Metropolitan Gas Companies will soon be required to increase the illuminating power of the gas they supply. Our own opinion is, that Scottish Companies will be compelled, by the failure of rich cannel, to reduce the power of their gas before we in London increase ours. Nevertheless, so soon as we are shown a process which will enable us to raise the illuminating power of gas from common coal, we shall be very happy to adopt it; it being thoroughly understood that the better the gas the more money the public will have to pay for it. There are two or three other points in Mr. M'Gilchrist's address which we should have been glad to notice, but space fails us.

The paper read by Mr. Aitken, "On the Influences of Aqueous "and Other Vapours on Illuminating Gas," also possesses many points of interest. We confess we do not quite understand the experiments on the influence of benzole and light naphtha vapour on illuminating power. They are, we rather think, opposed to general experience. That 1·6 gallons of light naphtha should cause an increase of illuminating power in ten thousand cubic feet of gas equal to that produced by 2 gallons of benzole, is remarkable. The influence of aqueous vapour, as determined by Mr. Aitken, is well worthy of attention, although it is of little practical importance, inasmuch as gas cannot be kept dry. Atmospheric air acts, it would appear, as a simple diluent, and beyond this it has no special influence, as some have supposed it had, in reducing the illuminating power of the gas. We are sorry that Mr. Aitken did not extend his experiments to the determination of the influence of carbonic acid on illuminating power, for we have a strong suspicion that erroneous notions prevail on the point. It would be well worth the while of any Gas Manager, who has apparatus and leisure, to make careful experiments on this matter.

We call the attention of our readers to the issue, this day, of the First Volume of our Treatise on the Manufacture and Distribution of Coal Gas. It is a handsome book (of four hundred and sixty pages, illustrated by five hundred and twenty-one woodcuts and thirty-seven page engravings) bound in morocco, with cloth sides, and gilt edges, and would form an ornament in the library, and useful guide in the office, of every Gas Engineer.

Water and Sanitary Notes.

It is never safe to prophesy till after the event. Misled by the papers of the House of Commons, we announced, last week, that Sir J. M. Hogg had withdrawn the Water Bills of the Metropolitan Board. Home Rulers, however, interfered, and the honourable baronet had no chance of bringing forward his motion. Others have stood in the way since, and Sir J. M. Hogg is now laid up with the gout, so we shall not pretend to say when the Bills will be withdrawn. It is enough for us to know that they are doomed.

The Metropolitan Board of Works seem incapable of taking a hint. The Home Secretary has told them, in tolerably plain language, that he is not satisfied with the Bill they have promoted for the Prevention of Thames Floods; and, at the same time, has intimated that he desires to see a Bill introduced to carry out the suggestions of the Select Committee of last year. The Board, however, have decided on writing to Mr. Cross, to ask him to more explicitly state his objections to their Bill. One of two things will happen—either the Board will receive a severe snubbing from the Home Secretary, who may bring in a Bill to carry out his own ideas, to resist which the Board will be powerless; or the unfortunate people on the south side of the river will be exposed for another year to all the risks of damage and discomfort by floods.

It would appear that the Corporation of Liverpool are considering a scheme for taking fifty million gallons of water daily from the Vyrnwy, one of the feeders of the Severn. This has alarmed the Severn Conservators, who protest, and are anxious to know what amount of compensation water they are likely to get. It seems that only two hundred million gallons of water, in ordinary seasons, flow over Digle's Weir, between Shrewsbury and Worcester, and thus the abstraction of fifty million gallons above this point is a very serious matter. We do not know whether or not the Liverpool Town Council have decided on attempting to carry out this scheme, but if they have they are certain to meet with great opposition.

Speaking of Liverpool reminds us to call attention to a very interesting essay, by Mr. Parry, C.E., of that city, on Water Power in Liverpool. Few people reflect that the streams which flow silently under our streets are capable of being utilized to exert an enormous amount of mechanical power. They are so utilized to a small extent in the Metropolis. Hydraulic lifts, and hydraulic engines for organ-blowing, are not uncommon, but might be more extensively employed. The worst part of it is that the water used in this way is, for the most part, lost, and we have not in the Metropolis a sufficient supply to be able to spare much to drive machinery. Other cities and towns are, however, more favourably situated; and, with an abundant

supply of water, might be able to spare a good deal for mechanical purposes. Mr. Parry, of course, refers to that inexhaustible source of power the tides, which, when coal begins to fail us, will, no doubt, be made to do much of our work.

We refer once more, with some reluctance, to the Stockton and Middlesbrough purchase, for we do not like to exult over the unfortunate Corporations. Now that everything is accomplished, except the settlement of the inevitable bill, the promoters of the scheme begin to recriminate. It is alleged that at one period in the course of the negotiations a somewhat informal offer for the sale of the undertaking was made for the consideration of £550,000. This price, however, was considered too high by some members of the Committee, who were in attendance in London, and who objected to close the bargain without consulting the ratepayers. The parliamentary proceedings were, therefore, continued, with a result which our readers know. The ratepayers, who were not consulted, have now a heavy burden to sustain for some years to come. We are very sorry for them, and are only inclined to blame their representatives, who neglected to keep the last commandment, which says, "Thou shalt "not covet thy neighbour's" goods.

Baron Norton, relieved from the cares of office, has time to devote to his own private affairs, and the first result is a letter to a Birmingham contemporary, complaining that an overflow of the Tame has flooded his meadows with Birmingham sewage, and completely spoilt his crop of grass, which is now worth nothing for mowing or pasture. This is bad news for the Corporation of Birmingham, who may perhaps hear something more of the matter. We have, at present, of course, only heard one side of the story. It may be shown that the mud deposited upon the noble lord's meadows was not contributed by Birmingham sewage, but was derived from quite a different source. We are given to understand that the sewage has, for a long time past, been most perfectly clarified; but it may be that, with an overwhelming amount of storm water running through the sewers into the tanks, the process of purification may not have been so complete as could have been desired. These accidents will probably always happen at times, until means are taken to separate storm water from sewage.

Société Technique de l'Industrie du Gaz en France.—The President has addressed a circular to the members, informing them that the meeting of the Society is fixed for the 24th of June and following days. The members of the British Association of Gas Managers who may be in Paris at that time are invited to be present. The Committee have decided to postpone until the 31st inst. the term previously fixed for sending in papers by candidates for the prizes already announced.

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For instance, if a hole were made in the retort-lid, and the mercurial thermometer inserted, will it be doubted for a moment what the result would be? The instrument would be destroyed, of course, but it would be rash to infer that its destruction was due to the temperature of the gas rather than to that of the retort itself. The same reasoning applies to the ascension-pipe within a short distance of the mouthpiece; the intensity of the heat from any source varying, like the power of a luminous body, inversely as the square of the distance.

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The distance of the point where the thermometer was inserted to the mouthpiece averaged abont 14 feet, and it will hardly be supposed that, within the short space named, the temperature of the gas could have fallen from above the boiling point of mercury, or over 652° Fahr., as stated by Mr. Paterson, to the rates which I have given, and especially when it is remembered that the temperature of the atmosphere over the bench was close on 100° at the time the trials were made. I venture this latter observation, having clearly in mind the researches of Dulong and Petit, who found that the rate of cooling is more rapid at high than at low temperatures.

Some further experiments directed to this question are in progress, the result of which I hope to communicate in a future letter.

Thomas Newbigging.

5, *Norfolk Street, Manchester, May* 18, 1878.

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Your correspondent says:

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2. "Suppose a gentleman having a 'hunting-box,' approached by a carriage road a mile long, and the entrance gate being within 75 feet of the Company's main, I take it that the gentleman would be entitled to a supply of gas to his house if he consented to pay all the expenses beyond the carriage entrance, even though, only for the domestic apartments and passages, the revenue might not be more than £15. I cannot help thinking that the Company might insist upon fixing the meter at the point where their gratuitous duties cease—viz., 25 yards from their main."

3. "In my own case a Government establishment is desirous of having the meter placed at a point 300 yards from the main; but I am insisting upon it being placed at the end of the 25 yards."

4. "I know several towns, with small villas from £20 to £80 a year, built in their own grounds, where it would cost from 20s. to 40s. to put on the services. Possibly the gas in these villas might only be used for a few weeks in the year, in the summer season, so that it would be utterly impossible that the consumption would repay the outlay."

5. "Undoubtedly, for every additional 10,000 feet of gas sold we have to carbonize more coal, pay more wages, and, sooner or later, put up more retorts and gasholders. An increased rental and a diminished expenditure for coal may arise from several causes—perhaps improved manufacture and distributing plant, &c."

The clauses in the Act of 1871 relating to this matter are as follows:—

"Clause 11.—The Company shall give, and continue to give, a supply of gas . . . and shall furnish and lay down any pipes that may be necessary for that purpose (within 25 yards)—10 yards at their own expense, and 15 yards at the occupier's expense."

"Clause 14.—The undertakers shall supply to any such occupier a meter for registering the gas supplied by them."

"Clause 15.—No consumer shall connect or disconnect any such meter to or from any pipes through which gas is supplied . . . without giving the Company 24 hours notice."

I will answer these points in succession as I have numbered them:—

1. There is nothing in either of the Acts of 1847 and 1871, the only two public Acts which regulate the proceedings of Gas Companies, to authorize a Company to insist upon the meter being fixed at any place on a consumer's premises they think necessary. Under the Act of 1871, the Company are required to give, and continue to give, a supply of gas, to provide and lay down a service, and to furnish a meter for registering the gas. Some Companies fix the meters themselves, and regulate the meter-rent so as to cover the cost of fixing, while others merely supply the meter for the consumer himself to fix. If, then, a Company laid down the service and fixed the meter at the end, all their obligations would be fulfilled, and no one would have any right to interfere. If, however, a Company merely laid down the service and capped it, and furnished the meter for the consumer himself to fix, and the consumer fixed it in a position that the Company disapproved of, all

the old Aldrington undertaking, and by this means enabling the Corporation to compete with the existing Companies, is quite worthy of a Town Councillor, who would see with satisfaction the streets torn up in every direction to gratify his favourite whim. The scheme, however, could not be revived without the sanction of Parliament, and the Legislature never allows Local Authorities to compete with Companies. Councillor Savage is perfectly right when he recommends his brother Councillors to take notice of the electric light, and advises them to abstain from gas manufacture. The worthy Councillor is a far-seeing chemist, who, no doubt, knows all about it. The Corporation had better at once make an experiment by illuminating the dome of the Pavilion with the electric light. They may thus acquire a knowledge of the relative cost of electricity and gas.

The Town Council of Winchester, contrary, we are certain, to the wishes of the inhabitants, have decided on lighting the city with oil for another year. The Gas Company refuse to contract for a shorter period than three years, and the Town Council decline to make an agreement for a longer term than one year. We may suppose that the Council expect gas to become cheaper and cheaper every year, and for that reason abstain from making a long contract. There is besides the bugbear of the electric light, which all enemies of Gas Companies affect to believe in. The Companies, however, are not so easily frightened. They can regard the advent of the electric light with perfect equanimity, and are, of course, not disconcerted by the appearance of sooty oil-lamps. The Winchester Gas Company made a really liberal offer; but its acceptance would have involved an expenditure on the part of the Council to undo some of the work which they had done. This was too bitter a pill for the majority of the Council to swallow. So the ratepayers are forced, by their obstinate representatives, to submit to the half-relieved darkness, against which they have almost unanimously protested.

The Local Government Board have sanctioned the borrowing of £71,000 by the Corporation of Stafford, to purchase the undertaking of the Stafford Gas Company. The Shareholders will, therefore, be paid off at once, and the Company dissolved.

The auction clauses are being applied by Mr. Raikes's Committee in what we might call a somewhat capricious manner. The York United Gas Company, whose Bill proposes to limit the dividend on new capital to five per cent., have escaped these clauses altogether. The Radcliffe and Pilkington Company, whose wish was to raise £120,000 entitled to seven per cent. dividend, have the auction clauses applied in respect of £80,000 of the new capital, while £40,000 remains to be distributed amongst the existing Shareholders. The reasons the Committee give for this are, that the Company supply a sparsely-populated district of large area, extensively undermined, which occasions a considerable loss from leakage. It seems also that the dividends of the Company have been but small, and at all times uncertain. It may be that in this case under the operation of the auction clauses, the present holders will be able to obtain new shares at something less than par, unless outsiders are willing to pay a high price for low and irregular profits.

At Shrewsbury, the Shareholders of the Gas Company were recently called upon to decide whether a portion of the new capital authorized by their Act, just passed, should be offered to the public by auction or tender. It was decided to put them up to auction, which, perhaps, is the best way of getting the longest price.

We commence to-day our report of the recent meeting of the West of Scotland Association of Gas Managers, and publish in the present number a useful and suggestive Address by the President, Mr. M'Gilchrist. He brings forward two or three practical points. There is, for instance, a question of the desirability of keeping in the gas the vapours of naphthas, which, condensed into liquids, flow into the tar-well, for the advantage of the tar distiller. There could be no question that the idea which is prevalent at the present time—viz., that of separating the tar from the crude gas at as high a temperature as possible—will, if carried into practice, assist in keeping the naphthas in solution in the gas; but, then, it must be remembered that gas carrying a large quantity of naphtha vapours will not stand much scrubbing without a decided loss of illuminating power. Some means must, therefore, be used for removing as much ammonia as possible before the scrubber is reached. It is not for us to pick out a process, from the many before the profession which promise to accomplish the desired end. Mr. M'Gilchrist seems to think that the Metropolitan Gas Companies will soon be required to increase the illuminating power of the gas they supply. Our own opinion is, that Scottish Companies will be compelled, by the failure of rich cannel, to reduce the power of their gas before we in London increase ours. Nevertheless, so soon as we are shown a process which will enable us to raise the illuminating power of gas from common coal, we shall be very happy to adopt it; it being thoroughly understood that the better the gas the more money the public will have to pay for it. There are two or three other points in Mr. M'Gilchrist's address which we should have been glad to notice, but space fails us.

The paper read by Mr. Aitken, "On the Influences of Aqueous "and Other Vapours on Illuminating Gas," also possesses many points of interest. We confess we do not quite understand the experiments on the influence of benzole and light naphtha vapour on illuminating power. They are, we rather think, opposed to general experience. That 1·6 gallons of light naphtha should cause an increase of illuminating power in ten thousand cubic feet of gas equal to that produced by 2 gallons of benzole, is remarkable. The influence of aqueous vapour, as determined by Mr. Aitken, is well worthy of attention, although it is of little practical importance, inasmuch as gas cannot be kept dry. Atmospheric air acts, it would appear, as a simple diluent, and beyond this it has no special influence, as some have supposed it had, in reducing the illuminating power of the gas. We are sorry that Mr. Aitken did not extend his experiments to the determination of the influence of carbonic acid on illuminating power, for we have a strong suspicion that erroneous notions prevail on the point. It would be well worth the while of any Gas Manager, who has apparatus and leisure, to make careful experiments on this matter.

We call the attention of our readers to the issue, this day, of the First Volume of our Treatise on the Manufacture and Distribution of Coal Gas. It is a handsome book (of four hundred and sixty pages, illustrated by five hundred and twenty-one woodcuts and thirty-seven page engravings) bound in morocco, with cloth sides, and gilt edges, and would form an ornament in the library, and useful guide in the office, of every Gas Engineer.

Water and Sanitary Notes.

It is never safe to prophesy till after the event. Misled by the papers of the House of Commons, we announced, last week, that Sir J. M. Hogg had withdrawn the Water Bills of the Metropolitan Board. Home Rulers, however, interfered, and the honourable baronet had no chance of bringing forward his motion. Others have stood in the way since, and Sir J. M. Hogg is now laid up with the gout, so we shall not pretend to say when the Bills will be withdrawn. It is enough for us to know that they are doomed.

The Metropolitan Board of Works seem incapable of taking a hint. The Home Secretary has told them, in tolerably plain language, that he is not satisfied with the Bill they have promoted for the Prevention of Thames Floods; and, at the same time, has intimated that he desires to see a Bill introduced to carry out the suggestions of the Select Committee of last year. The Board, however, have decided on writing to Mr. Cross, to ask him to more explicitly state his objections to their Bill. One of two things will happen—either the Board will receive a severe snubbing from the Home Secretary, who may bring in a Bill to carry out his own ideas, to resist which the Board will be powerless; or the unfortunate people on the south side of the river will be exposed for another year to all the risks of damage and discomfort by floods.

It would appear that the Corporation of Liverpool are considering a scheme for taking fifty million gallons of water daily from the Vyrnwy, one of the feeders of the Severn. This has alarmed the Severn Conservators, who protest, and are anxious to know what amount of compensation water they are likely to get. It seems that only two hundred million gallons of water, in ordinary seasons, flow over Digle's Weir, between Shrewsbury and Worcester, and thus the abstraction of fifty million gallons above this point is a very serious matter. We do not know whether or not the Liverpool Town Council have decided on attempting to carry out this scheme, but if they have they are certain to meet with great opposition.

Speaking of Liverpool reminds us to call attention to a very interesting essay, by Mr. Parry, C.E., of that city, on Water Power in Liverpool. Few people reflect that the streams which flow silently under our streets are capable of being utilized to exert an enormous amount of mechanical power. They are so utilized to a small extent in the Metropolis. Hydraulic lifts, and hydraulic engines for organ-blowing, are not uncommon, but might be more extensively employed. The worst part of it is that the water used in this way is, for the most part, lost, and we have not in the Metropolis a sufficient supply to be able to spare much to drive machinery. Other cities and towns are, however, more favourably situated; and, with an abundant

supply of water, might be able to spare a good deal for mechanical purposes. Mr. Parry, of course, refers to that inexhaustible source of power the tides, which, when coal begins to fail us, will, no doubt, be made to do much of our work.

We refer once more, with some reluctance, to the Stockton and Middlesbrough purchase, for we do not like to exult over the unfortunate Corporations. Now that everything is accomplished, except the settlement of the inevitable bill, the promoters of the scheme begin to recriminate. It is alleged that at one period in the course of the negotiations a somewhat informal offer for the sale of the undertaking was made for the consideration of £550,000. This price, however, was considered too high by some members of the Committee, who were in attendance in London, and who objected to close the bargain without consulting the ratepayers. The parliamentary proceedings were, therefore, continued, with a result which our readers know. The ratepayers, who were not consulted, have now a heavy burden to sustain for some years to come. We are very sorry for them, and are only inclined to blame their representatives, who neglected to keep the last commandment, which says, "Thou shalt not covet thy neighbour's" goods.

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that the Company could do would be to prohibit him making any connection with the service; but then he could summon the Company before a Magistrate for refusing a supply, and the Magistrate, in the absence of any express statutory provisions upon the point, might think the Company were not justified, under the circumstances, in withholding the supply and inflict a penalty.

2. The occupier of the hunting-box would most certainly be entitled to demand a supply if he consented to pay the expense of everything beyond the first 30 feet, but not if he only consented to pay the expenses beyond the entrance gate. The objections to laying these long services, even when the consumer is willing to pay for them, is, I presume, the risk of loss by leakage, which the Companies think, and very properly too, ought to be borne by the consumer, and not by themselves, it being caused by a specialty incident to the consumer's premises, over which the Company can have no control. If this is the only objection—and it is the only one that I can think of—the difficulty seems, to my mind, to be more imaginary than real, and to arise from some mistaken idea that a service must of necessity be of wrought iron; but all the Act says is, "any pipe that may be necessary for that purpose." No Company would dream of laying down a mile of wrought-iron pipe, nor would any person, even for his own sake, wish them to do so. But a mile of cast-iron pipe might be laid in a gentleman's grounds as free from escapes as the fittings in his own house.

A Company, on being applied to in such a way, need only say, "This is not a case in which the ordinary wrought-iron pipe can be used with safety; it must be a small cast-iron pipe, and we are prepared to lay down such a pipe, and pay our portion whenever you are prepared to do the same."

A revenue of £15 a year in a house of this description would be worth consideration to any Gas Company, large or small, and it would pay a Company handsomely to incur an outlay of £50, or even £100, to secure it. To speak of the supply being *only* for the domestic offices and passages, is simply absurd. Gas once introduced into a house in the domestic offices soon finds its own way into the dwelling apartments, and if it does not mount to the bed-rooms in a very short time, there is but one way of accounting for it, and that is "bad gas."

A Company's gratuitous service ceases at 30 feet (not 75 feet); all beyond 30 feet has to be paid for by the consumer; consequently, if the meters were fixed at the end of the gratuitous service, they would sometimes be in the public thoroughfare.

3. This seems to be a case where the service was a 3-inch main, and, if so, the motive for insisting upon the meter being fixed at any particular spot is, in the absence of any explanation to the contrary, incomprehensible. It seems to have been wholly unnecessary for the protection of the Company, and, consequently, a vexatious and arbitrary proceeding. A Manager should, of course, make his Company safe before anything else; but having done that, he serves his Company best by giving the consumer every possible facility for carrying the gas all over his premises in any way he thinks fit.

4. The maximum dividend allowed to Gas Companies is 10 per cent. To pay this upon an outlay of 20s. or 40s. would require a profit of 2s. or 4s., as the case might be. How any Gas Manager could convince himself that the consumption in houses of this character would not be sufficient to pay this, is utterly inconceivable. Had any Local Authority said that the Gas Manager in his district had made such a statement, no gas man would have believed it. If this is a fair representation of the proceedings of Gas Managers in country districts, country gentlemen may well complain, as they now do, of the narrow views and vexations restrictions of the country Companies. In estimating the probability of the consumption being remunerative, it is as easy and much more rational to assume that gas will be used freely in all parts of the house, as it is to assume that it will only be used for a short time in summer, and then very sparingly. It is not the duty of a Gas Manager to waste his time in these petty calculations as to the probability of each particular house being remunerative, and find obstacles to laying on the gas; but to sweep all obstacles out of his way, get the gas into every house, give an abundant supply and a good article, and rely upon the consumption, taking one house with the other, making an ample return upon all the outlay, however freely it may have been disbursed. No Manager who adopts this policy will ever find cause to regret it.

5. The remarks in my first letter upon this subject have been wrongly interpreted. I specially made use of the words, "within the compass of your plant," and these, in the reply, have been entirely lost sight of. The idea I wished to convey was this—that, while it is beyond doubt a Company supplying, say, 10,000,000 feet a year, with an increase of 1,000,000 feet, must carbonize more coal, and pay more wages; nevertheless, if the increase is only 50,000 or 100,000 feet, that additional quantity may, as likely as not, be provided without additional expense either for coals or wages. For instance, the quantity per ton of coals may in one year be only 9300 feet, but in the next 9500; and there are many ways in which the production may be affected; hence the folly of saying that for every additional 10,000 feet brought into the ledger, you have to carbonize more coal and pay more wages, or that the small consumptions are not remunerative. As I cannot help thinking that, if this point were clearly understood, many of these captious objections to laying on the gas would disappear, I will endeavour to explain it further in some other way.

The average profit of small Gas Companies may be taken at one-fourth of the gross receipts—that is to say, out of every £100 of gross receipts (gas, residuals, and everything else), £75 goes to working expenses, and £25 to profit. If this is taken as a standard at the termination of any financial year, and compared with the next, it will be found that for every £100 increase of rental the working expenses have only increased £25; but the profits have increased £75. The increase then becomes merged in the general account, and benefits that to some slight extent—say one-quarter or one-half per cent.—and this process goes on from year to year, until, after a series of years, it is found that the average profit has been increased by these extensions from 25 to 35 per cent., or even more. These proportions will, of course, only apply while all the circumstances remain the same. There might be, in the same time, an increase in the Directors allowances, or in the Officers salaries, or some other special circumstances to affect the result; but, in the absence of all special circumstances, this, or something very much like it, will be the result, and any Manager can test it by his own operations.

The Metropolitan Gas Companies, under the Act of 1860, are required to send their accounts every year to the Board of Trade, and the Board lay them before Parliament, when they are printed and sold as a parliamentary paper. From these papers I have extracted the following particulars of the gross receipts from all sources and profits of the several Companies made collectively for the years 1861 and 1864:—

In 1861 the gross receipts were	£1,751,980
And the profits were	493,711
In 1864 the gross receipts were	£2,090,752
And the profits were	718,374

That is, in 1861 the profits were 28 per cent. of the gross receipts, and in 1864, 34¼ per cent.

But the point to which I specially desire to direct attention, as illustrating this subject more forcibly than anything else, is this: Between the 31st of December, 1861, and the same day in 1864 (three years) the increase in the receipts was £338,772, and the increase in the profits £224,663, showing that the profits on the extensions were, within a very small fraction, two-thirds of the whole receipts. And this is by no means an exceptionally favourable result, as some of the Companies had reduced their price, and all of them had been put to large additional expenses to carry out the obligations imposed by the Act of 1860, and had made large allowances in other respects as well.

Some of the Companies accounts, individually, show results more favourable than this, and others less so; but this is the average of thirteen. If the figures could be worked out accurately, they would, in all probability, show a more favourable result for the average; but, even as it is, it ought to be sufficient to convince any one of the extreme folly of pursuing the mistaken policy of restricting the supply.

Sam Slick, when he first commenced trading in the clock line, in the backwoods of America, always took care, whenever he made a call, to have two clocks with him, and if he failed to sell one off-hand he asked permission, as the houses were far apart, to leave one until he came back, and this the parties supposing would either be that day or the next, always graciously permitted, when Sam put the clock in some conspicuous place, set it going, and departed. Instead, however, of going back the same day or the next, Sam never went back for six months, "calculating" that the parties would use the clock in the meanwhile, and so acquire the habit, and then be unwilling to part with it; and the result proved the correctness of his "calculations," for he never had but one to take back, and that was under very special circumstances. When he got to the end of his journey, he had only one clock left, and that was "pretty considerably" damaged; so he painted it up to look quite smart, and persuaded the last man he called upon to take it off his hands as a much better article, give him five dollars more, and allow him to bring the other away, which, having thus been paid for, Sam thought he might as well appropriate to his own use. Some time after, on being remonstrated with for selling a clock that would not go at all, Sam explained that, in telling the gentleman it was a better article, he had said "looking," though, perhaps, the gentleman had not heard him.

I do not presume to recommend the latter part of Sam's proceedings to Gas Managers, but I think some of them might take a hint from the former part. Get the gas into every house on the chance of the use of it becoming a habit, which the occupiers would not afterwards be willing to part with.

W. LIVESEY.

Gas and Water Companies Association, 6, Victoria Street, Westminster, May 18, 1878.

AIR AS FUEL.

SIR,—With your permission, I should like to ask a question in reference to heating retorts. I have set a bed of four retorts, with the intention of trying to heat them partly by air. The plan I have adopted seems to answer very well, except that the furnace sides are burnt out so fast; and this is my difficulty. I can get a good heat with less fuel. I have a flue running the length of the retorts, by which I admit the cold air; it then travels back through another flue, and is admitted into the furnace, by which time it has become hot. I should like to know if any other manager has tried this or a similar process, and with what results. I should be glad also to hear, through the JOURNAL, any suggestions for getting over the difficulty I have mentioned.

J. W.

P.S.—I omitted to say that I have two air-flues, one on each side of the furnace.

THE SALES OF GAS ACT.

SIR,—Is it lawful for a Gas Company or Corporation, who have not adopted the Sales of Gas Act, to sell gas by meters which have not been stamped according to the Sales of Gas Act?

Are all towns and boroughs in the United Kingdom compelled to adopt the Sales of Gas Act, or is it optional for them to do so?

Can any Gas Company or Corporation, who have not adopted the Sales of Gas Act, clean and repair meters and use them again, without having them tested and re-stamped according to the Sales of Gas Act?

If any of my brother managers can name any Acts of Parliament bearing on the above questions, they will greatly oblige.

GAS MANAGER.

LEICESTER WATER-WORKS COMPANY.—A special meeting of Shareholders was held on the 13th inst., to sanction the Bill now before Parliament for the transfer of the undertaking of the Company to the Corporation. Mr. E. S. Ellis presided, and the heads of the Bill having been read over, he moved its approval, remarking that it had already passed the House of Lords, and the Shareholders had now, in accordance with the requirements of Parliament, an opportunity of considering again the terms which had been offered them by the Corporation for the purchase of their works, and they were at liberty, if they chose, of declining those terms, and of declaring the purchase to be at an end; but he did not apprehend that any such course would be taken. After some conversation on a minor point of detail, the Bill was approved. The Chairman, in responding to a vote of thanks, said there would be one more meeting to declare a dividend, and then they would probably not have occasion to meet again.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, May 13.

The Chairman of Committees informed the House that the opposition to the South Staffordshire Water Bill was withdrawn.

The Examiners reported that the further Standing Orders applicable to the Scarborough Corporation Water Bill, and the Scarborough Water Bill, have been complied with; and that no further Standing Orders are applicable to the Limerick Corporation Gas Bill.

Lewes Gas Bill, Nottingham Improvement (Gas, &c.) Bill,—read a second time, and committed.

East Retford Borough Bill, Hamilton Burgh Bill, Hemel Hempsted District Gas Bill, Maryport Improvement Bill, Stoke-upon-Trent Corporation Gas Bill,—brought from the Commons, read the first time, and referred to the Examiners.

Petitions were presented against the Cardiff Water Bill, from the Corporation of Cardiff; and against the Limerick Corporation Gas Bill, from Merchants, traders, and ratepayers of Limerick.

Tuesday, May 14.

The Chairman of Committees informed the House that the opposition to the Nottingham Improvement (Gas, &c.) Bill was withdrawn.

Truro Water Bill,—reported without amendment.

Lea Bridge District Gas Bill, Tredegar Water and Gas Bill, West Houghton Local Board Bill,—read a second time, and committed.

Thursday, May 16.

Dalton-in-Furness Local Board Bill,—reported with amendments.

Nottingham Water Bill,—reported without amendment.

West Houghton Local Board Bill,—reported with an amendment.

Limerick Corporation Gas Bill, Scarborough Corporation Water Bill, Scarborough Water Bill,—read a second time, and committed.

Manchester Corporation Water Bill, brought from the Commons, read the first time, and referred to the Examiners.

Public Health Act (1875) Amendment Bill,—brought from the Commons, and read the first time

Friday, May 17.

The Examiners reported that the further Standing Orders applicable to the Hemel Hempsted District Gas Bill and the Stoke-upon-Trent Corporation Gas Bill have been complied with; that no further Standing Orders are applicable to the Hamilton Burgh Bill; and that the further proofs required by the Standing Orders Committee in respect of the South Staffordshire Water Bill have been given.

East Grinstead Gas and Water Bill, Mansfield Commissioners Gas Bill, South Hants Water Bill, South Staffordshire Water Bill,—reported with amendments.

Lea Bridge District Gas Bill, Lewes Gas Bill, Scarborough Water Bill,—reported without amendment.

Truro Water Bill,—read the third time, and passed.

HOUSE OF COMMONS.

Monday, May 13.

Warrington Water Bill (Lords),—read a second time, and committed.

The Examiners reported that the Standing Orders not previously inquired into, and which are applicable thereto, have been complied with in the case of the Trowbridge Water Bill (Lords); and that the Standing Order which is applicable thereto has been complied with in the case of the Local Government Provisional Orders (Droitwich, &c.) Bill.

Metropolis Water-Works (Purchase) Bill,—adjourned debate on amendment on second reading further adjourned till Monday, May 20.

Gas and Water Orders Confirmation Bill,—read a second time, and committed.

Tuesday, May 14.

Manchester Corporation Water Bill,—read the third time, and passed.

York United Gas Bill (Lords),—read the third time, and passed without amendment.

Weston-super-Mare Improvement Commissioners Bill,—as amended, considered; amendments made; to be read the third time.

Burton-upon-Trent Commissioners Bill (Lords), Clitheroe Gas, Water, and Improvement Bill (Lords),—reported with amendments.

The Examiners reported that the Standing Orders not previously inquired into have not been complied with in the case of the Leicester Corporation Bill.

Local Government Provisional Orders (Droitwich, &c.) Bill,—read a second time, and committed.

Public Health Act (1875) Amendment Bill,—as amended, considered; clause (power to require water-rates to be levied) added; to be read the third time.

Wednesday, May 15.

Public Health Act (1875) Amendment Bill,—read the third time, and passed.

Friday, May 17.

Bedlington Local Board Water Bill (Lords),—reported, with an amendment.

Radcliffe and Pilkington Gas Bill,—as amended, considered; to be read the third time.

Lichfield Gas Bill (Lords),—read the first time, and referred to the Examiners.

HOUSE OF COMMONS COMMITTEES.

Tuesday, March 19.

(*Before Mr.* J. Holms, *Chairman*; *Mr.* W. G. Cartwright, *Mr.* Barne, *and Mr.* Bowen; *Mr.* Bonham-Carter, *Referee.*)

NOTTINGHAM WATER BILL.

NOTTINGHAM IMPROVEMENT, GAS, AND WATER BILL.

Sir Edmund Beckett, Q.C., Mr. Pope, Q.C., and Mr. Michael appeared for the Nottingham Water-Works Company, promoters of the first Bill, and in opposition to the second; Mr. Bidder, Q.C., and Mr. Venables, Q.C., for the Corporation of Nottingham, promoters of the second Bill, and petitioners against the Bill of the Water Company. Mr. Pembroke Stephens also opposed the last named Bill on behalf of the Hucknall Local Board.

Sir E. Beckett said: Sir, the Bill for which I appear, and which is promoted by the Nottingham Water-Works Company, is simply a Bill to enable that Company to raise more capital for the purpose of supplying a larger area with water than they do at present. The Bill is opposed by the Corporation, and the question which they raise in their petition was discussed and settled two or three years ago. There is another opposition from the Hucknall Local Board, of which I cannot speak in the same way. One of the places we propose to include in our scheme is the township of Hucknall Torkard, which has a Local Board, and the people have come to the conclusion that we can supply them with water cheaper than they can supply themselves. The Corporation petition goes into the history of the Water Company, and therefore it is unnecessary for me to do so. It will be sufficient to begin with 1845, when the present Company were incorporated or re-incorporated out of one or two Companies that had previously existed for a considerable time. In 1845 the present Company were incorporated with a capital of £75,000, and with the right to pay a dividend of 10 per cent., as Water Companies generally have. You will see shortly why I emphasize this at the present moment. In 1854 a financial operation took place of a somewhat complicated kind, but which I think you will be easily able to understand. The Company wanted to increase their capital by £100,000, and it was arranged between them and the Corporation that this £75,000, which was capital receiving 10 per cent., should be increased to £150,000, bearing dividend after the rate of 5 per cent., being, of course, the same thing. I suppose the object of that was simplification, and inasmuch as the Company were willing to raise their new capital, limited to 5 per cent., it was simply to make that change with regard to the whole capital, and say that the capital of the Company should be £150,000, with a dividend of 5 per cent., instead of having two dividends, one of 10 per cent., and the other of 5 per cent. From that time all the capital has been raised at 5 per cent. We do not propose to alter this now, although the new capital is capable of bearing a dividend of 7 or 7½ per cent. At that time the Company volunteered to do another thing, which I confess I have not been able to see the wisdom of yet. They volunteered for some financial reasons of their own to sell all the new shares they were entitled to issue by Act of Parliament, by auction, insead of distributing them, as they were entitled to do under the Companies Clauses Act, among existing shareholders. It was the fashion in those days to sell new shares by auction, but I think the practice has been quite given up now, and I do not believe there is a single Company in England for supplying water under the obligation of issuing shares by auction. It has been several times attempted, but it has never succeeded, and of course we do not propose to do it now. We propose to give the public of Nottingham the benefit of raising new capital at 5 per cent., instead of 7 or 10 per cent. In carrying on the history of the Company, I next mention the Bill of 1869. In 1869 the Company were in want of more water, and they brought in a Bill for getting a supply from Dover Beck, in the neighbourhood of Nottingham. That was opposed by the landowners, among whom was the late Speaker, who gave evidence in favour of a friend of his, or tenant. The Company were enabled to make an extremely good bargain—I do not mean a pecuniary bargain, but an excellent sanitary bargain—for they were able to supply with good water such large places as Basford. Nottingham and the suburbs were increasing, as the area of large manufacturing towns do rapidly increase; and a further supply of water was needed. The Company, therefore, in that year completed arrangements with the Duke of St. Albans, to enable them to get a good supply of water from the red sandstone; and if the present Bill is passed we shall be able to get an equally good supply of water, and to take in such places as Greasley, Eastwood, Papplewick, and other important places in the district. There cannot be a much simpler case than this. We are supplying them because they wish to be supplied, and I have here memorials they have presented to us at different times. I desire only to refer particularly to the memorial from Hucknall, the inhabitants of which have had an interview with the Company, being represented by various influential people, and a discussion took place. Inasmuch as Hucknall has changed its mind, it is necessary I should call your attention to their memorial, dated Dec. 3, 1877, addressed to the Directors of the Nottingham Water-Works Company. The memorialists stated that they had learned with pleasure that it was the intention of the Company to apply to Parliament for powers to supply the parish with water, that they were satisfied the Company could supply them very much cheaper than they could supply themselves, and they took the opportunity of urging upon the Company the desirability of losing no time in bringing the supply to Hucknall. The memorial is signed by the Duke of Portland, who, I see, owns 2900 acres in the parish out of a little more than 3000 acres, and by many other people, owning among them a large number of houses. We had given notice of the Bill before receiving this memorial. This matter, however, has been greatly discussed for some time, and we knew the views of the people on the question. I suppose they sent this memorial because they knew there was opposition on the part of the Local Board, who wanted to supply the water themselves. In this case, then, we have the Local Board acting, not only against the wishes of the landowners, but against the householders of the place. We shall see presently whether the Local Board are wise in doing it or not. I desire to call particular attention to the fact that the owners of property at Hucknall are satisfied that we can supply them with water more cheaply than they can supply themselves. That was gone into at a meeting which took place, and a statement was made by one of the representatives, I think, of the Duke of Portland, that, even if we charged the maximum rate, we could do it for £950 a year. That is a matter of absolute certainty, whereas the estimates of the Local Board for these works—and every one knows how fallacious estimates are—were £1260, besides what they would have to charge from time to time. As to the necessity of supplying Hucknall with water, I need not enter into the question, because when two people are going to do the same thing, the necessity is assured. We have the means of supplying all the large places around, as well as Nottingham, with excellent water, not only as regards quantity, but quality. Returning, however, to the Corporation dispute, I may mention that, in 1874, the Corporation tried in the House of Lords, and also in the House of Commons, to get auction clauses imposed upon the Company, but failed. And I may add that not only did the Corporation of Nottingham fail, but many other Corporations have also failed in similar efforts. Among these are the Corporation of Sunderland, the Corporation of Liverpool, and the Corporation of Chesterfield. These applications were similar to the action of the Corporation of Nottingham in this case, and in every instance they failed to persuade Parliament to compel the Companies to sell shares by auction. Why, therefore, the Corporation of Nottingham should now try to obtain this power I do not know. The Corporation wanted to get possession of the Company's works, and there were ways and means of doing so, by offering such terms as were agreeable to the Company, but why they should get them by compulsion I am at a loss to understand. I do not remember that this has ever been sanctioned, with the exception of one case last year, where strong proof was given that the Company were not carrying out their undertaking satisfactorily, and where it was shown that they were unable to do so on account of the water being insufficient in quality, and this case was that of the Stockton and Middlesbrough Water Company. By an Act of 1866, that Company were enabled to take a limited quantity of water from the River Tees. In 1875 they desired to obtain powers for increasing that quantity, but this was objected to by those interested in the River Tees, their contention being that the water was required for purposes of navigation, and so on; and it was also objected to on the ground that the water of the Tees was not fit to drink. The Company had been before Parliament the year before with

exactly the same case, asking for power to get more water from the Tees, and the view taken of the case by Parliament was that, having already refused their application, the Corporation should have the power to buy the works at an arbitration price. The price at which the works should be acquired was fixed at 25 years purchase of the statutory dividend, and in addition to that it was referred to an arbitrator to fix a sum to be paid by the Corporations as compensation in the matter of future profits. In the matter of Nottingham, however, the case is directly opposed to this. The water supplied by the Nottingham Company is not only unimpeachable, but unimpeached; and this speaks even more strongly for it: in 1874 we challenged them in every way to produce any one from Nottingham who would find the slightest fault with the water in any way, as regarded the price, the quality, or the supply. The supply was constant, the water excellent, and the rates low. Among the witnesses examined at that time was an Alderman of the borough, whom I challenged to point out a single deficiency, and he was unable to do so; the only thing he could say was that the Corporation would like to have the water-works, as they thought they could make a good thing of them. No doubt they could if they got them at their own price, but I do not see why the Company are to be compelled to sell any more than any one else, unless at the price they freely agree upon; or why, indeed, they should part with their works by arbitration, unless it can be shown that such a course would be for the public good. While the supply is good and sufficient, I do not see why there should be any interference with the Company. I said all this with success in the year 1874 in both Houses of Parliament, and I shall be greatly surprised if I do not say it with the same success here, for no reason can be shown for deviating from the course already adopted. The Corporation cannot say that the auction clauses were imposed in 1854 by their proposition. I have read an account of the proceeding, and can only say that they were volunteered by the Company for purposes of their own. But if this had not been the case it would not signify, for since then Parliament has changed its mind, and has refused to impose the auction clauses on water companies. What is wanted to be done with this Company is, in short, to confiscate all further profits, and to annihilate the Companies Clauses Act, by which the shares are to be issued on such terms as the Company think fit. Now, if this proceeding is wrong, there should be a new Act to affect all Companies. It is also stated that the accounts filed by the Company are insufficient, and the Corporation state they are willing to purchase and carry on the water-works undertaking upon fair terms. They have offered us terms which we have refused to accept, and I cannot see why we should be bound to do so. Then with regard to the Bill to which the Corporation want to get the consent of Parliament. We are in conflict with them about the third part, the 11th clause of which really gives the Corporation power to step in at a favourable moment for themselves at any time within three years, and compel the Company to sell by arbitration.

Mr. VENABLES: That clause has been altered, and now the term is one year.

Sir E. BECKETT: If so, then the alteration gets rid of these remarks in detail; but there is the general objection. The clause is compulsory on both sides that the works shall be sold within a year at the arbitration price. As to precedents, there are one or two cases that I might mention and one in particular, that of Birmingham. Two or three years ago there was a Bill brought forward for the Corporation of Birmingham to buy the water-works. Some years previously the Corporation had agreed with the Company to sell the water-works. The Company, for some reason or other, offered to sell, but the Corporation for some time did not think fit to purchase; afterwards they wished to do it. Meanwhile the Company had extended their works, and for that reason and others the Corporation were told that it was no use filing a Bill in Chancery for the specific purposes of that agreement, for the Court could not decree. Therefore, as that could not be entertained, it was necessary to come to the Supreme Court of Equity, namely Parliament, to enforce the agreement volunteered years before. That was in 1876. The agreement had been made as long ago as 1851. It was an agreement of the Company to sell, with power to the Corporation to buy when they thought fit. In the House of Commons, for some reason, the Company withdrew and the Bill was unopposed, but the opposition was carried into the House of Lords, and they had to decide whether the agreement should be enforced or not. The Committee then expressed an opinion directly against the power of Corporations to purchase water-works compulsorily or by arbitration. This affords the strongest possible precedent for our case. With the exception of Stockton, my friend has not a single precedent in his favour, and that was sanctioned for the reasons I have stated. There is some objection to be made to the 12th clause, and the 13th is also to be objected to. As everybody knows, the general Act of Parliament put in force for the purpose of obtaining works of this kind is the Lands Clauses Act. Even in the case of Stockton, where such a very strong view was taken of the conduct of the Company, it was determined that the Lands Clauses Act was the one under which the proceedings should be carried out, and there were also certain sums to be stated by the arbitrator. In this case, however, the Corporation of Nottingham propose that the Railway Clauses Act shall be the one under which the value shall be determined. Now, under the Railway Act the costs of the arbitration, which are sometimes enormous, are to be paid as the arbitrator may direct, while under the Lands Clauses Act they have to be paid by the purchaser. Now, why should the costs be thrown upon us, or any portion of them? What have we done to deserve punishment? If we had done our work badly there might be some reason for this. An objection has also to be taken to the 24th clause, which in effect would give the Corporation a hold upon our annuities, leaving us to whistle for them. If the Company do part with the works to the Corporation, they ought to have some thoroughly good security upon the Corporation by means of the borough or district rate, or whatever they call it. I think I have now told the Committee all that it is necessary for me to state, and I will proceed to call witnesses in support of the Bill of the Company, proving the necessity for the extension of the district, and verifying and justifying what I have said.

Mr. *Thomas Hawksley*, examined by Mr. MICHAEL.

I am a Civil Engineer, and a Past President of the Institution of Civil Engineers. For many years I have had experience in water-works, and I have devoted a great deal of attention to those works. I was in 1830 appointed Engineer to the Nottingham Water Company. I constructed the works at that time. Those works were completed in 1831, and were the first I ever constructed on my own account. I have been Engineer of the undertaking ever since. I may say it is one of the finest water-works undertakings in the kingdom. It is now about ten times the size that it was originally. It has many country stations, and the district is traversed by miles and miles of pipes. The works originally for the supply of Nottingham were instituted about 1696. The supply of water was primarily obtained and continued for many years from the Leen, which runs at the lower side of the town. That continued till 1835 before any new works were undertaken, which was ultimately done because the Leen was becoming gradually polluted. During the period of the existence of the works Nottingham has increased in population from 7000 to about 40,000 inhabitants. In 1835 a Company made application to Parliament to become a Corporation for the purpose of obtaining water, and getting their supply from the River Trent. They received incorporation in the following year. They did not carry out their works at once. They were unable to do so because of the commercial crisis at that time. In consequence the Company were unable to raise the necessary funds. The old Company, in 1827, obtained an Act of Incorporation. Subsequently the two Companies, as was usual at that period in such cases, carried on business in a manner that was very hostile. If water was laid on by one Company one day, there was a good chance that it would be cut off by the other Company the next day. That went on till 1845, when the amalgamation of the two Companies took place. I was appointed by both Companies to value their undertakings, and, in fact, to amalgamate them. They were amalgamated on the terms which I arranged, and an Act of Parliament was passed for the purpose. The capital was then fixed at £75,000, entitled to 10 per cent., with borrowing powers of £25,000, or a total capital of £100,000. At that time the Nottingham Enclosure Act came into operation, of which Act I was the chief promoter. In 1845 the Bill authorizing the enclosure of 1200 or 1400 acres of land was passed, which gave immediately five millions of money to the Nottingham Corporation, and as a consequence that quantity of land was immediately thrown open, as soon as the streets could be laid out, for building purposes. The result was that the Company were put to a very considerable expense indeed in piping and in pumping to a higher level to supply all this new town. There was a difference of opinion on the Board of Directors. Some who held old shares were desirous that the Company should not enter into larger additional expenditure, which would be prejudicial to the value of the old shares by a temporary reduction of the dividends. Others were quite willing to accept their position, and provide for the extensions. However, after very much debate between the two parties, one Director proposed, in order to raise the money at the least possible rate under the exigency of the case, that in the allotment of shares they should be sold by auction, and the premiums thus obtained should be put into the works without bearing dividends. That process came about in the way I have mentioned, and under the circumstances I have mentioned, immediately after the passing of the Act of 1845; and it continued as long as the Company's capital lasted—that is to say, till £75,000 had been laid out, and after that the Company were reduced to the necessity of making a further application to Parliament. In 1854 a Bill for that purpose was introduced. In the deposited Bill it was proposed to raise a further sum of £75,000, subject to a 10 per cent. dividend, all to be sold by auction, to be brought down to the current rate of interest of the day. The current rate of interest at that time was 4½ or 5 per cent. The step thus taken was not the result of any pressure put upon the Company by the Corporation. The process began years before that, and continued so long as there was any capital to sell. Of course the Company always meant to obtain a return for their money, and that afterwards they should be recouped, and their shares replaced upon the ordinary footing. That was in contemplation till about four years ago, when Parliament required us to continue the 5 per cent. allotment, but without any auction clauses. The shares were to be allotted in the usual way.

By the CHAIRMAN: In 1854 the Company duplicated their original capital of £75,000, which was entitled to 10 per cent., and converted it into £150,000 at 5 per cent. The Corporation did not oppose the Bill, but they interfered in a manner which I did not understand at that time, but I have since been able to surmise its meaning. The Corporation wished that there should be a statement in the Act that the maximum should be £2 10s. upon a £50 share—that is to say, that a dividend of 5 per cent. should be expressed. The Company had no objection to that, as it was, in fact, the purpose and object of their own proposition, and it was adopted. Upon that the Corporation said that it was at their dictation that the 5 per cent. limit was imposed. In 1874 it was proposed to increase the rate of interest which the Company might receive to 7 per cent., because it was thought the time had arrived when, by the success of their undertaking, they should have the usual reward of all their work, and they expected 7 per cent. upon their additional capital, but not upon the capital previously granted—that being the usual rate of dividend, in other water-works, upon new capital. The Bill came on in the House of Lords, and was opposed by the Corporation. It passed that House, and was even more intently opposed in the Commons. The Bill, however, was practically passed as proposed by the Company, except that 5 per cent. dividend was fixed instead of 7 per cent. The Company accepted the restriction of both Houses of Parliament, and now ask for capital at 5 per cent., not seeking to alter it. We propose to raise further capital entitled to a dividend of 5 per cent. only, but not subject to the auction clauses to which we are not now subject, and I believe there is not one Water Company who are subject to auction clauses. The rate of 5 per cent. is also exceptional.

Examination continued: This Company were the first to attain the condition of a high-pressure supply; and not only have we done that, but we have continued it absolutely without cessation from 1831 till the present time. The Nottingham Company have been the cause of the spread of that system all over the kingdom. The quality of the water is very beautiful, chiefly obtained from the red sandstone strata, and it is lifted to various heights, so that we are able to supply the whole of the district with water at high pressure. Practically, the water is never off at all. People use it *ad libitum* day and night. There is no restriction at all to its use. The rates are very moderate indeed. I do not think they are quite the lowest, but they are very nearly the lowest of any town in the kingdom. We supply all manufacturers, and all demands for sanitary purposes. For a house of the annual value of £5, the charge would be 4s. 8d. a year, or a little more than a penny a week—*i.e.*, for a penny a week about five persons are supplied with water. That is a constant supply at high pressure. In Rochdale the charge is 7s. 6d.; in Birmingham it is 6s.; in Bury and Bradford it is 7s. 6d.; in Oldham it is 6s. 8d.; in Bolton it is 7s. 6d.; and so on.

By the CHAIRMAN: The highest is Sheffield, at 8s. 11½d. I will take a house at £10 annual value. Our rate is 11s.; Rochdale, £1; Birmingham, 10s.; Bury, 15s.; Heywood, 15s.; Bradford, 15s.; Oldham, 13s. 4d.; Bolton, 12s. 8d.; and Sheffield is 15s. In that case I think Rochdale is the highest. The rates under different Acts of Parliament are not at all consistent with each other. At Manchester the charge is 7s. 6d.

Examination resumed: Many towns where the Corporations have the water supply in hand have public rates in addition. The 7s. 6d. in Manchester is equivalent to an outlay of 5d. in the pound, because it is levied on all properties alike; whereas the Company can only levy upon house property. I cannot give you the exact amount, because there is a difference between the rate and the value. I suppose the Manchester rate would be equal to about 11s. 6d. The rest are valued in about the same proportion, but you will see that as the scale extends we are lower in proportion than in the cases I have already quoted. We have also commenced in the class of small houses, and have extended the system somewhat on a larger scale, by making an allowance to the landlord for payment in the gross. We also provide the houses with communication-pipes at our own expense. It was this Company who established that system, which has been only partially applied in a very few other towns. This Company have also erected 1500 hydrants in various parts of the district at a cost of about £6000. We further keep a large staff of people for our own benefit and that of our customers, to look after the taps both external and internal, and we

maintain them in repair till they are utterly worn out. We have six stations a the present time, and we have four reservoirs—two at the sources. We have four high-level reservoirs, eight steam-engines, and a water-engine. The sources of our present supply are all deep wells sunk in the sandstone formation; but we have also to take water from the River Trent. The last right we do not exercise, and have not exercised for many years. Our present capabilities of supply amount to 7 million gallons per day. The requirements I average at a maximum of 4 million gallons, going down to nearly 3. Practically, there is a capability of 6 million gallons, for there must always be a margin left, as against requirements of 4 millions. In the district we supply there are 32,000 or 33,000 houses, with others in course of erection, so that it would not be unfair to estimate the population at 170,000 persons. We have 106 or 107 miles of mains. We have never refused to supply any district, nor, as far as I know, any house. We always anticipate the wants of the districts as much as possible, and lay down mains in the streets before the houses are built. Our income is £35,500 a year, and our debt now is £6000; but I hope that will be paid off on March 25, 1880. The amount of capital raised by premiums on shares alone is £28,000. Then the ancient Company accumulated a great deal of property, chiefly land, and that is worth within a few pounds of £25,000. That, added to the £28,000, would give £53,000 of capital not bearing interest. Altogether there is about £78,000 in the undertaking not bearing interest. The district which we seek to supply has a population of about 32,000. Our pipes go up to the borders of Hucknall. Nottingham is as dependent upon them as they are upon Nottingham, and as we are private capitalists, having a right to supply water, we propose to give these places the blessing of an ample supply. There is no other supply but from the red sandstone, and we practically hold the key in that respect. We have large works already at Bestwood, and we have a high-pressure reservoir, called the Red Hill Service Reservoir. By an arrangement with the Duke of St. Albans, we have a right to the whole of the water in the large sandstone district—about 5000 acres around Arnold. We have also the right to take water from several thousand acres, which are distinguished on the map as Linby and Papplewick. We have no works there at present, nor shall we have, I suppose, unless this Bill is passed. From that district we can obtain an additional 3 million gallons of water. The proposed additional works would be beyond Papplewick, and it is proposed to bring water from that source for the supply of New Brinsley, Brinsley, Eastwood, Greasley, Newthorpe, Kimberley, and so on, and for us to do that it would not take more than a month. When the new lines are made they will naturally travel through Hucknall. We could avoid it, but the natural road is through Hucknall; and Mr. Montague, who is one of the large proprietors of land in this district, has arranged with us for the direct road to the places we propose to supply. He is in favour of our scheme, and opposes that of Hucknall to supply itself with water. Our scheme provides for a natural extension of our area for the good of the community. The rateable value of the rents is lower in this district than in Nottingham, and, therefore, we shall add 25 per cent. to the rates, and no one objects, or raises an objection to it. There is nothing in the petition of the Corporation but a desire to become possessors, compulsorily, of the undertaking of the Company. We have never given them any cause of complaint in any way; but ours is one of the finest investments, and one of the best conducted water-works in the kingdom, and that cannot and will not be denied.

Cross-examined by Mr. BIDDER: In only one case has Parliament sanctioned the compulsory transfer of water-works, and that was hardly a case of compulsion, because negotiations had proceeded between the Company and the Corporations previously. I refer to the case of Stockton and Middlesbrough.

Mr. BIDDER; I was one of the Counsel in that case, and remember it well. Do you mean to suggest that there was no compulsory purchase?

Witness: It was a compulsory purchase, but it was not compulsory in the ordinary sense of the word, because the parties had been in negotiation, and ultimately there was a *quasi* willing vendor.

Cross-examination continued: The Nottingham Company do not pay a very high rate of dividend; they do not pay one shilling more than Parliament has sanctioned. They do not always pay maximum dividends. They are now paying up about £6000 of arrears. The Company have been going on steadily and gradually for some years past increasing about £2500 a year, on the average, and there has been a steady growth of the mains in the district. In 1854 we obtained leave to raise £100,000 new capital for the general purposes of the undertaking, and that capital was spent very carefully and economically, and lasted about 20 years. In 1868 we again applied, but failed, and in 1873 we came for extended powers and £25,000. We asked for 7 per cent. on that capital, which is the same as is allowed to other water companies. The Corporation opposed us, and Parliament did not grant it. In 1874 we applied for £100,000, which we thought would meet our immediate wants. We again asked for 7 per cent., and the Corporation opposed, desiring to cut down our dividend to 5 per cent., and in that they succeeded. At that time I estimated that the £100,000 would last us for 16 or 20 years. That money has been expended, and I can tell you where it has gone to exactly. I was wrong in estimating it would last so long. I was then looking into the middle of next week, whereas I am now looking into the middle of last week. I was looking then into the future, with all its uncertainties; but now I am looking into the past, with all its certainties. Whether I was right or wrong is quite immaterial if the money has been properly, and usefully, and beneficially expended, as I am prepared to show it has been. In a very few months after the Company obtained the money they allotted the shares. £19 5s. shares issued and called up are worth now in the market about £28 10s. or £29. That is to say they are now at about 50 per cent. premium.

Mr. BIDDER: Therefore have not the Shareholders, in consequence of obtaining this £100,000, put into their pockets £50,000?

Witness: They have not taken it out of anybody else's pocket.

Mr. BIDDER: In point of fact, the premiums have reached about £17,000 a year?

Witness: You call it premium; well, I will call it bonus or windfall. The additional sum should not come out of the pockets of the ratepayers, but out of the market, with which the ratepayers had nothing to do. If I choose to give you for certain shares 40 or 50 per cent. premium, it is a matter between ourselves, and the Corporation have nothing to do with it.

Cross-examination continued: The maximum dividends amount to about £18,000 per annum. The greater part of the £100,000 has gone in paying off bonds and debts. I cannot tell whether the Company have any unexercised power of raising money on debentures. The power to raise £25,000, under the Act of 1874, was not by debentures but by loans. The 12th section gives them power to borrow upon mortgage any sum not exceeding £25,000, but that is different from raising money upon debenture stock, which is in the nature of shares to which a particular kind of preference is attached. That is saleable in the market, and may be sold from hand to hand for a profit price. We have raised money by borrowing; even during the past year £8000 has been borrowed under the general powers of the Company. I can form no idea how long the £150,000 now asked for will last. I am not going to prophesy again; having failed once, I am not going to guarantee anything in this world again. The new districts will cost about £60,000. We shall not have to spend any considerable amount in erecting any additional pumping-station for some time, because the one at Bestwood is competent for the supply of the new district for years. In that respect my prophesy was right. I cannot tell you how many years it will be, but we shall have, by and by, to erect a new pumping-station on Mr. Montague's land. We have acquired a site of about 10 acres for that purpose. I can tell you that not one farthing of the Company's money has been spent otherwise than profitably. As to the additional capital being a godsend to the Shareholders to the extent of £75,000, that depends on the value. If the money were expended—and it never would be except usefully—it might get up to that.

Mr. BIDDER: It has got up to that rate in the other cases already.

Witness: Because there have been causes, and I hope there always will be. There will be more people to take the water, and therefore more to pay. They are increasing by thousands, and all these mouths must be filled. I think it likely we may hereafter have to come to Parliament for another £150,000.

Cross-examination continued: I am informed that the last raised capital has all been expended with the exception of about £3000. We have supplied three districts, including Beeston and Arnold, and we have paid off some loans and a large amount of debt. I am perfectly sure that the money has all gone in a perfectly legitimate way. The figures produced refer to the expenditure of the money during three years. With regard to the £28,000 for mains, the mains for the supply from the Red Hill reservoir were laid, and the work was in progress, in 1874. I cannot tell you how much has been spent on the works since 1874. We have still power to raise £39,300 on mortgage, and we can raise money on superfluous land, but that bordering the Trent would have to be brought into the market as building land in small proportions. It might in reality be worth £25,000, but it is not practicable at present to force it into the market. We might raise £40,000 on debentures to-morrow, if we chose to get heavily into debt, instead of on shares; but we have a natural repugnance to mortgage debts, and when we are obliged to resort to them we do it unwillingly. The shares of any company always sell better in the market when there is not a large claim in the shape of mortgages. We mean to raise the money we are authorized to raise on mortgage, by the Act of 1874, if occasion requires, but by preference we should like to raise it by shares, thus to have all the people holding claims upon the profit rowing in the same boat. My advice has always been, never get into debt if you can help it. As a matter of preference I should say that I would rather raise money by share capital. I have no means of answering whether, if Parliament grants us the additional share capital now asked for, we shall not exercise the borrowing powers of the Act of 1874; that would be my view of the matter, but I am not the Company.

By Mr. STEPHENS: The extensions proposed by this Bill will nearly double the area of the Company's operations, and for the new area a differential rate of 25 per cent. is proposed, but that is not 25 per cent. more than is being paid in Nottingham. The rate is levied according to the rent of the house, and a £12 house in Nottingham would not be worth more than £8 in these outlying districts, consequently the rate would not be higher either per head or per house. I attach much importance to the supply of Hucknall Torkard. There are 8000 people there, and our pipes go through it, or alongside it. The area of Hucknall is 3200 acres, of which 2900 belong to the Duke of Portland. We could supply it in a month. The idea of taking in Hucknall must have been in the minds of the Company for a couple of years. We were in Parliament in 1874 for an extension of limits, and we proposed then to take in Hucknall, but something occurred in the town of Nottingham which induced the Board to strike out a number of the places. I cannot say that the Company deliberately abandoned this scheme, nor can I give their reasons for doing it. I know, however that a letter was written to the Parliamentary Agent to withdraw these places from the Bill.

Mr. MICHAEL: I believe they were in the parliamentary notice, but not in the Bill as deposited.

Witness: I think that was the case. There are two additional works required for the supply of Hucknall, but a tenth of the cost of getting the water from the Red Hill reservoir ought to fall upon Hucknall in proportion to the supply. The supply of Hucknall would be as valuable to the Company in the matter of service, as Parliament Street might be to Charing Cross. Water Companies have the right of laying pipes along any public highway in their districts. Our direct road is through the heart of the village. With regard to the basin of which mention has been made, there were many people to be consulted before an agreement could be come to between Mr. Montague and the Water Company, and the agreement produced which refers to the matter is a private one of Mr. Montague's. Several years ago I made a survey of the Hucknall district, and recommended a source of supply upon Mr. Montague's estate. That was as far as the matter proceeded. There were no negotiations with Mr. Montague so far as I am aware. A new idea, suggested by the Local Government Board of that day, was broached, to the effect that there should be a combined district, consisting of Hucknall, Bulwell, Greasley, and Eastwood, for the purposes of water supply, but that also fell through. In July, 1874, I saw no violent impropriety in Hucknall getting a supply for itself by pumping on Mr. Montague's estate, for they must get it from somewhere, and there was then, in my opinion, no other service open to them. But what was right and proper—and even necessary—under the then circumstances, is becoming wrong and improper under existing circumstances. We care so little about Hucknall *per se*, that you might cast it out and do us no harm, but it lies in the direct line to Eastwood, and our pipes going there we can, with our large undertaking, supply them better than they can possibly supply themselves with their small undertaking. An agreement has been entered into, by which a rate is to be paid to Mr. Montague for the use we shall make of his estate. Unless we get these powers within five years the agreement falls through, but we have to pay the rate for the time, and in perpetuity if the Bill is carried.

(To be continued.)

FRIDAY, MAY 10.

(Before Mr. RAIKES, *Chairman of Ways and Means; Mr.* HARDCASTLE; *and Mr.* RICKARDS, *Referee.)*

RADCLIFFE AND PILKINGTON GAS BILL.

This was an unopposed Bill, and the Committee reported as follows to the House:—

"The Bill empowers the Company to acquire additional lands for the purpose of extending and enlarging their gas-works, and to raise further moneys in order to meet the increased demands for gas within their authorized limits of supply.

"This Company is in an exceptional position. Its district is of great area, and for the most part sparsely populated. Its outlay is comparatively large, and its income comparatively small. Moreover, in consequence of extensive mining operations, the loss of gas by leakage is very considerable. The dividends of the Company have of late years been greatly reduced, and have been subject to many fluctuations, whereby the value of the share property has been detrimentally affected. The

dividend upon the larger portion of the present capital of the Company is limited by the Act authorizing such capital to 7 per cent., and the dividend upon the whole of the new capital of £120,000 is limited by the Bill to the same rate. Under these circumstances the Committee are of opinion that the requirements of Standing Order No. 188A will be sufficiently met by requiring the sale by auction or tender of £80,000 of such new capital, and they have made provision in the Bill accordingly.

"The Committee have examined the allegations of the Bill, and found the same to be true, and have gone through the Bill, and made amendments thereunto."

(*Before Mr.* RAIKES, *Chairman of Ways and Means; Mr.* STACPOOLE; *and Mr.* RICKARDS, *Referee.*)

YORK UNITED GAS BILL (LORDS).

Messrs. DYSON and Co. appeared as Agents for this Bill, which has passed the House of Lords, and now came before the Committee as an unopposed measure.

In the course of the proceedings,

Mr. RICKARDS asked: To what interest is the new capital limited?

The AGENT: Five per cent.

The CHAIRMAN: What is the meaning of clause 21?

The AGENT: It debars the Company from converting borrowed money into capital. The clause was inserted at the suggestion of the Corporation, who were afraid something of the kind might be done.

Mr. RICKARDS: What is your present price for gas?

The AGENT: Two shillings and sixpence, and we find we cannot live at that.

The CHAIRMAN: The price is much lower than that charged by other Companies?

The AGENT: Yes.

The CHAIRMAN: Well, we allow the Bill to pass through, and shall in our report mention that the price charged is very low.

The following is the report of the Committee to the House:—

"The Bill empowers the Company to enlarge their gas-works, to extend their district of supply, and to raise £80,000 additional capital.

"The dividend on such additional capital is limited by the Bill to 5 per cent. per annum, and the Committee therefore have not thought it necessary to introduce a provision for the offer of such capital by public auction or tender.

"They have examined the allegations of the Bill, and found the same to be true, and have gone through the Bill, and directed the Chairman to report the same without amendment."

Miscellaneous News.

METROPOLIS GAS SUPPLY.

Dr. Whitmore's report on the illuminating power, pressure, and quality of the coal gas consumed in the parish of Marylebone, and supplied by The Gaslight and Coke Company, during April:—

	Illuminating Power in Sperm Candles.			Mean Pressure in Tenths of an Inch.		Mean Quanty. of Sulphur in 100 Cu. Ft.	Mean Quanty. of Ammon. in 100 Cu. Ft.	Sulphuretted Hydrogn.
	*Mean of 22 Obser.	Highest.	Lowest.	Highest.	Lowest.	Grains.	Grains.	
Gas supplied from the Fulham works	16·87	17·31	16·2	18·82	9·64	17·26	0·26	No trace
Gas supplied from the Beckton and Bow works	16·73	17·34	16·31	40·42	19·28	13·16	0·26	No trace
Cannel gas supplied from the Pimlico works	20·96	22·03	20·02	22·00	12·97	13 03	0·06	No trace

Mean of daily readings of barometer . . . 29·60
" " " thermometer . . . 61·46

* Each observation consists of ten readings of the photometer, at intervals of one minute.

The mean illuminating power of all the three gases supplied to the parish during the month was very nearly a candle in excess of the standard, and on no occasion did either of them fall below it, whilst on several occasions the excess was from a candle and a half to two candles. The mean quantity of sulphur found in 100 cubic feet of the gas supplied from Fulham was about 17 grains; in the other two gases it was only about 13 grains, whilst as regards ammonia it was virtually *nil*. The pressure was generally satisfactory, and on no occasion was sulphuretted hydrogen detected in either of the gases by the ordinary tests. It is only fair to state that the gas supplied to this parish, during the past month, was unusually good, both as regards illuminating power and freedom from impurity.

Dr. Stevenson's report on the gas supplied by The Gaslight and Coke Company to the Vestry of St. Pancras, during the month of April, 1878:—Maximum light estimated by sperm candles, according to the Act—18·5. Minimum light, sperm candles—18·6. Average light, sperm candles—17·2. Traces of ammonia, indicated by turmeric test paper—Traces on all occasions. Traces of sulphuretted hydrogen, indicated by lead test paper—None on any occasion. Sulphur 14·5 grains per 100 cubic feet.

METROPOLIS WATER SUPPLY.

THE ABORTIVE SCHEMES OF THE METROPOLITAN BOARD.—On Friday last a deputation conveyed the thanks of the Vestry of St. Pancras to Sir Thomas Chambers, at the hall of the Middle Temple, for the services he had rendered by his opposition to the proposal for transferring the water-works of the Metropolis to the jurisdiction of the Metropolitan Board of Works.

Dr. Frankland reports as the result of his analyses of the waters supplied to the Metropolis and some of its suburbs during April, that taking the average amount of organic impurity in a given volume of the Kent Company's water during the nine years, ending December, 1876, to represent unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies was—Colne Valley 1·3, Kent 1·3, New River 1·7, East London 2·7, West Middlesex 3·0, Lambeth 3·1, Grand Junction 3·1, Southwark 3·8, and Chelsea 3·8. The water abstracted from the Thames and Lea, by seven out of the eight Companies supplying the inner circle, exhibited a marked improvement when compared with the corresponding samples collected in March. It was also in all cases efficiently filtered before delivery. The water supplied by the Kent and Colne Valley Companies was bright, wholesome, palatable, and of its usual excellent quality. The softest water supplied by other Companies was three times as hard as that delivered by the Colne Valley Company. Seen through a stratum 2 feet deep, the water supplied by the Kent and Colne Valley Companies, was clear and colourless; the New River Company's water was clear and nearly colourless; that delivered by the Chelsea, West Middlesex, Southwark, Lambeth, and East London Companies, clear and very pale yellow; and that by the Grand Junction Company, clear and very pale yellowish brown.

Results of Analysis expressed in Parts per 100,000.

Companies or Local Authorities.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.
Inner Circle.								
Thames—								
Chelsea	26·74	·188	·036	0	·206	·242	1·5	20·6
West Middlesex	25·62	·142	·034	0	·230	·264	1·6	21·2
Southwark and Vauxhall	26·10	·176	·046	0	·219	·265	1·5	20·6
Grand Junction	26·82	·145	·037	0	·201	·238	1·5	20·4
Lambeth	28·06	·152	·028	0	·163	·191	1·6	20 6
Other Sources—								
New River	25·12	·072	·028	0	·288	·316	1·6	20·0
East London	30·18	·128	·030	0	·245	·275	1·8	21·2
Kent	38·92	·059	·019	0	·464	·483	2·5	27·4
Outer Circle.								
Colne Valley	13·94	·054	·021	0	·336	·357	1·4	6·7
Tottenham Local Board	—	—	—	0	—	—	—	—
Corporation of Birmingham*	24·30	·303	·047	·002	·321	·369	1·9	13·8
Corporation of Glasgow†	3·29	·130	·020	0	·005	·025	0·55	1·27

* Analyzed by Dr. Alfred Hill, Medical Officer of Health and Analyst to the Borough.
† Analyzed by Dr. E. J. Mills, F.R.S., of Anderson's College, Glasgow.
Note.—The numbers in the analytical table can be converted into grains per imperial gallon by multiplying them by seven, and then moving the decimal point one place to the left. The same operation transforms the hardness in the table into degrees of hardness on Clark's scale.

The Registrar-General publishes the following returns of the average daily quantity of water supplied by the London Water Companies during the month of April. According to these, 118,335,453 gallons, or 537,652 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 217 gallons (98·6 decalitres), rather less than a *ton* by weight, to each house, and 30·6 gallons (13·9 decalitres) to each person, against 29·9 gallons during April, 1877.

Companies.	Number of Houses, &c., supplied in April, 1877.	April, 1878.	Aver. Daily Supply of Water in Gallons* during April, 1877.	April, 1878.
Total supply	532,166	544,381	113,059,770	118,335,453
From Thames	249,548	256,903	57,103,563	59,302,563
" Lea and other Sources	282,618	287,478	55,956,207	59,032,890
THAMES.				
Chelsea	28,741	29,014	7,163,360	8,132,300
West Middlesex	49,035	50,562	9,814,214	9,300,265
Southwark and Vauxhall	77,380	80,375	17,250,000	18,200,000
Grand Junction	37,683	38,462	10,815,949	10,693,898
Lambeth	56,209	58,499	12,061,000	12,926,100
LEA AND OTHER SOURCES.				
New River	125,219	126,563	24,368,000	26,315,000
East London	111,967	115,143	24,908,780	25,576,590
Kent	45,432	45,772	6,679,427	7,141,309

* Including that for manufactures and for various purposes other than for domestic consumption.
Note.—The return for April, 1878, as compared with that for the corresponding month of 1877, shows an increase of houses, and of 5,275,683 gallons of water supplied daily.

Dr. Whitmore's report on the composition of Thames Companies and other waters consumed in Marylebone during April:—

	In Grains, per Gallon.			In Parts, per Million.		In Degrees.	
	Total Solid Matter.	Loss by Incineration.*	Chlorine.	Free Ammonia.	Albumenoid Ammonia.	Hardness.	Hardness after boiling Fifteen Minutes.
West Middlesex	18·00	0·80	1·08	0·02	0·06	12·4	2·7
Grand Junction	20·10	0·90	1·06	0·01	0·08	13·8	3·0

* The loss by incineration represents the amount of organic and other volatile matters contained in the Imperial gallon (70,000 grains) of water. The total solid matter, *minus* such loss, consisted largely of carbonate of lime, with small quantities of other equally harmless salts.

The water of both Companies, as drawn from the mains, when seen through a stratum of two feet in thickness, was clear and bright, and no living organisms were detected in either by the microscope. The water as taken from the Thames at Hampton, the point of intake of both the above Companies, was only slightly turbid. In this water living and moving organisms were found.

WIMBLEDON PUBLIC LIGHTING.—At the meeting of the Wimbledon Local Board on the 15th inst., a letter was read from the Mitcham Gas Company, in which they undertook to light 265 public lamps from the 1st of June next to the 31st of May, 1879, inclusive, at £5 2s. 6d. per lamp, and from the 1st of August next to the 31st of May, 1879, at £4 5s. 6d., the times of lighting, extinguishing, and other conditions to be the same as at present. This is a reduction of 4s. 6d. per lamp upon the existing terms. It was resolved that a contract for the ten months be entered into with the Company.

UCKFIELD GAS COMPANY.—The annual meeting was held on the 3rd inst. The balance-sheet showed that the amount received from private consumers for gas-rental had continued to steadily increase, the income from that source for the year just ended being £853 10s. 4d., against £789 19s. 10d. in the previous year. There had been received for coke and tar £119 2s. 9d. This was less than in the previous year, owing to the mildness of the past winter affecting the price of fuel. The Directors had paid off during the year half of the debenture loan—viz., £200—leaving £200 still owing on that account. There was a balance, after providing for the amount owing on debentures, and interest, of £483 5s. 3d. available for dividend and reserve. It was resolved to appropriate £200 of this balance in payment of a dividend, at the rate of 10 per cent., to the Shareholders, leaving sufficient in hand to pay for the year's supply of coals, and so form a reserve.

ROCHDALE CORPORATION GAS-WORKS.

Report of the Gas Committee.

To the Council of the Borough of Rochdale.

The Gas Committee present the following report on their department for the year ending March 25, 1878.

Notwithstanding the reduction made in the price of gas last year, equivalent in the aggregate to over £4000 per annum, your Committee are pleased to inform you that, in consequence of more favourable coal contracts, and by a more careful supervision exercised over the manufacturing department, the profits during the past year are the largest that have ever been realized. After paying interest and 1-75th part of debt, and all other liabilities, the surplus profits amount to £8622 9s. 2½d.

The coke receipts are about the same this year as last. The per centage of coke sold is 37 per cent. of the material carbonized; last year being 33 per cent.

Your Committee have not thought it wise during the past winter to work the hydraulic stoking machinery, in consequence of two-thirds of the retorts then in use being of small size. Renewals are now being made, and when completed, all retorts will be of the size required for the successful working by machinery.

Considerable expense has been incurred during the year by the failure of one of the gasholder-tanks, which required considerable alterations to be made in the construction, in order to prevent the recurrence of a similar accident. The tank is now satisfactory, and all expenses connected therewith have been charged to revenue account.

The new governor-house and offices are now nearly completed, the station-governors placed in position, and the connecting-mains are now being laid. The respective governors will supply respective districts, and thus give a more perfect control over the total area of supply than has hitherto been attained.

It is the intention of your Committee, during this year, to replace the No. 1 station-meter with one of a larger capacity, as it is proved that the present means of registering the gas manufactured in winter is unreliable.

The following brief summary represents a comparative view of the working for the year ending March 25, 1878, and March 31, 1877, viz.:—

	Cubic Feet.
Gas made this year to the 25th of March. No. 1 station-meter registering incorrectly	—
Gas made last year to the 31st of March	—
Decrease	—
Gas sold and used this year	219,577,900
Ditto last year	221,391,000
Decrease	1,813,100

Value of gas sold, after deducting discounts, this year	£43,297 15 11½
Ditto ditto last year	47,435 4 3½
Decrease	£4,137 8 4
The profits this year amount to	£8,622 9 2½
Ditto last year amounted to	6,903 1 6½
Increase	£1,719 7 8
The present number of consumers is	19,312
Last year the number of consumers was	18,550
Increase	762
New lamp services laid this year	21
Making total new services laid this year	783
2672 yards of new and additional main-pipes have been laid during the past year in various roads and streets, at a cost of	£1,368 17 9
The services referred to above cost	394 8 0
Extensions on works during year	2,261 15 6
Making total amount chargeable to capital	£4,025 1 3

The following statements give the size and number of meters in use, the quarterly and annual average illuminating power and purity of gas supplied during the past year, also the maximum and minimum tests each quarter.

Number and Size of Wet Meters in use up to March 25, 1878.

Lights No.	2	3	5	10	15	20	30	50	60	80
Meters No.	15098	1333	858	391	17	132	84	65	1	36

Number and Size of Wet Meters (continued).

Lights No.	100	150	200	250	260	300	400	500	600	700	Total.
Meters No.	37	41	34	1	1	3	0	1	1	1	18135

Number and Size of Dry Meters in use up to March 25, 1878.

Lights No.	2	3	5	10	20	30	50	60	80	100	150	Total.
Meters No.	28	5	18	14	10	2	7	1	2	1	2	90

During the year the illuminating power of the gas has been tested daily on the Sugg-Letheby photometer, the gas being consumed in a "London" standard Argand burner at the rate of 5 cubic feet per hour, against two standard sperm candles, each consuming 120 grains of sperm per hour, corrections being made for barometric pressure and temperature, if required. The quantity of gas consumed each quarter is also given.

—	Gas Consumed.	Max.	Min.	Average.
Quarter ending June	26,309,700	19·70	16·80	18·29 candles.
Do. September	29,134,600	18·00	16·00	17·13 ,,
Do. December.	90,638,800	19·90	16·60	17·95 ,,
Do. March	73,494,800	19·60	17·30	18·29 ,,
Total for year	219,577,900	Yearly average		17·91 candles.

Table showing Proportions of Sulphur in other Forms than Sulphuretted Hydrogen in Grains per 100 Cubic Feet of Gas.

—	Maximum.	Minimum.	Average.
Quarter ending June	21·44	10·90	17·31
Do. September	16·48	10·31	14·43
Do. December	13·36	4·99	9·83
Do. March	16·20	9·88	12·65
Yearly average	13·55		

Only on one occasion the quantity of sulphur found exceeded that allowed by Act of Parliament, being 1·44 grains in excess.

With regard to sulphuretted hydrogen, this impurity has, with few exceptions, been detected in the ordinary and continual test.

The gas has also been remarkably free from ammonia, only showing, on rare occasions, traces of this impurity.

(Signed) William J. Petrie, Chairman.

May 2, 1878.

Dr.—*Profit and Loss Account from March* 31, 1877, *to March* 25, 1878.

To Gas-rental, general account		£40,340 0 5½	
Public lamps, including lighting, extinguishing, cleaning, and repairs		4,970 16 4	
Public lamps, Castleton Local Board		139 5 7	
Do., Wuerdle and Wardle do.		91 3 0	
Sundry accounts		31 19 9	
			£45,593 5 1¼
Tar and ammoniacal liquor		£3,227 13 8½	
Coke		2,643 8 4	
Fitting trade		144 2 5	
Cottage rents		24 4 6	
			6,039 8 11½
			£51,632 14 1

Cr.—*Profit and Loss Account.*

By Carbonization—			
Stokers wages		£3,158 3 10½	
Coal and cannel	£17,507 18 2		
Horse and cart work	993 13 4½		
Men's wages, unloading, stacking, &c.	532 16 0½		
		19,034 7 7	
			£22,192 11 5½
Purification—			
Wages		£364 8 10	
Lime		276 9 2	
Oxide of iron		184 0 9	
		£824 18 9	
Less spent oxide and lime sold		299 9 11½	
			525 8 9½
Yard labour—			
Wages		£589 3 1½	
Cartage		172 12 5	
			761 15 6½
Wear and tear, retorts—			
Wages		£404 18 10½	
Retorts, &c.		584 19 0	
Castings		158 7 0	
Cartage		28 13 8	
		£1,176 18 6½	
Less materials sold		3 15 5	
			1,173 3 1½
Wear and tear, works and tools—			
Wages		£730 17 11	
Ironwork		558 14 3	
Joiners, slaters, and masons		231 17 11	
Oil, paint, and cement		157 1 0	
Hemp, waste, and lead		17 11 0	
Water-rent		79 2 9	
Cartage		32 1 0	
Sundries		71 11 2	
Drains and pipes		103 10 0	
		£1,982 7 0	
Less old iron, &c., sold		26 5 0½	
			1,956 1 11½
Wear and tear, mains and services—			
Wages		£249 12 1	
Pipes and castings		542 14 10½	
Sundry materials		73 4 11	
Lead		33 0 0	
Cartage		53 18 0	
Paving		97 0 11	
		£1,049 10 0½	
Less materials sold, &c.		394 1 4½	
			655 9 5
Meter inspection, wages			565 8 6
Salaries and office expenses—			
Salaries		£908 7 8	
Auditing		15 0 0	
Printing, stationery, stamps, &c.		174 18 3	
			1,098 5 11
Miscellaneous expenses—			
Travelling expenses		£34 14 9	
Commission, per bank		35 0 0	
Advertisements		34 2 11	
Professional charges (Newbigging's)		70 3 6	
Compensation		37 2 10	
Sundries		9 17 4	
		£241 1 4	
Less meter-books sold		6 4 2	
			234 17 2
Wear and tear, lamps—			
Wages		£959 16 1	
Repairs and materials		125 6 3	
		£1,085 2 4	
Less materials sold		17 18 9	
			1,067 3 7
Rent of land		£161 14 1	
Rent, rates, and taxes		1,223 17 3	
			1,385 11 4
Discounts on gas-rental		£2,295 9 2	
Bad debts, estimated		60 0 0	
			2,355 9 2
Interest on loan account		£7,045 15 3	
1-75th part of mortgage debt to sinking-fund		1,993 3 8	
			9,038 18 11
Balance, being profit			8,622 9 2½
			£51,632 14 1

Dr.—*Balance-Sheet.*

Assets.

To Value of gas-works, as per last year's balance-sheet				£161,839	17	2
Less amount allowed for depreciation, being 1-75th part of debt				1,993	3	8
					£159,846	13 6
Amount expended from April 1, 1877, to March 25, 1878—						
Mains	£1,368	17	9			
New services	394	8	0			
New governors, governor-house, offices, &c.	759	0	11			
Hydraulic stokers	535	8	5			
Extension of No. 3 retort-bed	364	6	0			
Paving Dane Street	283	16	5			
New drains	233	9	10			
No. 4 gasholder-tank	4	12	5			
New lamps	102	4	0			
	£4,046	3	9			
Less balance of purchase and sale of horses and carts	21	2	6			
				4,025	1	3
Present value of works					£163,871	14 9
Amounts due—						
Gas-rental	£12,854	19	8½			
Public lamps rental	4,970	16	4			
Do. Castleton Local Board	51	11	5			
Do. Wuerdle and Wardle Local Board	42	5	7			
Sundries ledger	1,470	5	3½			
Fittings ledger	62	1	5			
				19,451	19	9
Stocks, as per details in stock-book—						
Coal and cannel	£1,788	15	0			
Main-pipes	898	19	5			
Fitting trade	566	5	3			
Wear and tear of mains, &c.	538	15	5			
Oxide of iron	40	0	0			
				3,832	15	1
Amount advanced to Contractor on account of new governor-house, offices, &c.				878	0	0
Balance in the Manchester and Liverpool District Banking Company				4,830	5	11
Balance, cash in hand				0	0	0½
				£192,864	15	6½

Cr.—*Balance-Sheet.*

Liabilities.

By Amount of mortgage debt, as per last year's balance-sheet				£141,736	0	3
Amount borrowed this year				30,000	0	0
				£171,736	0	3
Amount borrowed from depreciation-fund				9,063	2	11
				£180,799	3	2
Less 1-75th part of debt paid over to the Finance Committee for sinking-fund				1,993	3	8
					£178,805	19 6
Debts owing on trade account					5,153	16 10
Bad debts on gas-rental					274	12 6
Deposits, being amount paid in advance for gas					7	17 6
Balance, as per profit and loss account					8,622	9 2½
					£192,864	15 6½
Total amount of money borrowed					£214,413	2 11
Amount of depreciation-fund				£9,063	2	11
Mortgage debt paid off from March 31, 1853				35,607	3	5
					44,670	6 4
Mortgage debt owing March 25, 1878					£169,742	16 7

Dr.—*Capital Account.*

1844 To Amount paid late Gas Company, and expenses incident to purchase				£27,700	0	0
Extension of gas-works, 1845 to 1878				176,778	18	2
Balance				9,934	4	9
				£214,413	2	11

Cr.—*Capital Account.*

1844 By Amount borrowed from Hand in Hand Assurance Society				£27,700	0	0
1845 Amount borrowed from depreciation-fund				464	17	1
1846 Amount borrowed from various persons				1,750	0	0
1853 Amount borrowed from depreciation-fund				8,598	5	10
Amount borrowed from various persons, 1853 to 1878 (including £2000 borrowed from the Finance Committee in 1866)				175,900	0	0
				£214,413	2	11

WALTON-ON-THE-NAZE GAS AND WATER COMPANY.

The Board of Trade have, under section 4 of the Gas and Water Works Facilities Act, 1870, made a Provisional Order in the case of the application of this Company, notwithstanding that the consent of one of the Local Authorities was not obtained. The application was for authority to maintain, continue, and extend existing gas-works, and to maintain and continue existing water-works in Walton-on-the-Naze, and to construct two wells, with pumping-station and reservoir, in the parish of Frinton, for the supply of potable water to Walton-on-the-Naze. The Local Authorities are the Walton-on-the-Naze Improvement Commissioners (acting under their local Act of 1841, and acting also as the Urban Sanitary Authority, under the Public Health Act of 1875) and the Local Board of Frinton. The former Authority having refused their consent to the granting of the Order, the Board of Trade appointed Major Marindin, R.E., one of their Inspecting Officers, to hold a public inquiry, and to report to them on the matter. The Local Government Board Inspector for the district was present on the occasion. The report of Major Marindin was as follows:—

There is absolute need for the early provision of a proper supply of potable water, the existing supply, although there is considerable difference in the analyses of it submitted, being admittedly quite unfit for drinking.

There is also great need for proper appliances for delivering the existing supply for public purposes, so that the drains may be properly flushed. At present they are neither flushed nor ventilated, and, no doubt, some of the bad smells attributed to the gas-works are really due to this want.

The Urban Authorities have been, since 1876, pressed by the Local Government Board to take steps to provide proper water for the town, but have done very little, and have matured no scheme.

The finances of the Urban Authorities are admitted to be in an embarrassed state, and the Commissioners own that they would be glad to be relieved by any substantial Company from the obligation to undertake works for the supply of water.

Under these circumstances, therefore, and after duly considering the evidence and arguments on either side, I am of opinion that the Order should be granted; for, although it cannot be denied that the present site of the gas-works is objectionable to the surrounding householders, yet the supply of good water is of paramount importance to the whole population, whose interests must first be considered, and I believe that the best, if not the only, means by which such supply can be obtained, within any reasonable time, is by giving the necessary powers to this Company.

The past action of the Commissioners does not encourage the hope that they would be able to cope with the difficulty, while the doubts raised by them as to the resources of the Company have, I think, insufficient grounds. It is true that the works are in a great measure the property of one individual, but he is the largest owner of property in Walton, and is the proprietor of the land proposed to be assigned, and these very facts afford fair ground for thinking that this Company is more likely to find the necessary funds than any other body connected with the place.

It would, no doubt, be better if the gas-works could be moved, but this cannot be insisted upon. In the interests, however, of the surrounding householders, powers should not be given for storing residual products, or for any increase in the appliances for the manufacture.

The Board of Trade accordingly dispensed with the consent of the Walton-on-the-Naze Improvement Commissioners, and made a Provisional Order embodying this and other recommendations of Major Marindin.

NORTH OF ENGLAND GAS MANAGERS ASSOCIATION.

(*Continued from p. 766.*)

Mr. Watson (of the firm of T. S. Johnson and Co.) read the following paper on

IMPROVEMENTS IN THE MANUFACTURE OF PORTLAND CEMENT.

Scarcely has the comparatively short space of 50 years elapsed since the first bushel of Portland cement was produced, and well-nigh half that period had passed away ere it appeared before the public as an article likely to compete successfully with other hydraulic cements. The makers of Roman cement used every means in their power to impede the growing reputation of Portland, but their exertions were not crowned with success.

The late Sir Robert Peel, labouring under an impression that "Roman" was the only hydraulic cement extant, and fearing that the raw material from which it is produced was being exhausted, was led to speak at considerable length in the House of Commons, regarding the advisability of imposing a tax on the material, so as to reserve a sufficient supply for the purposes of Government works.

One of the few Portland cement makers, hearing of this, had an interview with Sir Robert on the subject, produced samples of Portland, and evidence sufficient to prove that there was little cause to be alarmed as to the supply of a hydraulic cement, and in consequence the proposed tax was abandoned.

It is not my intention to weary you with a category of the vicissitudes in the history of Portland cement; the multitude of purposes for which it is used is the best evidence that can be presented of the increasing popularity and established reputation it enjoys.

As the great extent of its application has increased, so has it been the aim of the careful cement maker to obtain increasingly satisfactory results from his manufacture; and considering that the specifications issued by several Governments, and other important Works throughout the world, at times contain conditions so stringent, it is imperative that the manufacturer employ his talents to the very best of his ability in perfecting the manipulation, so as to produce a cement capable of giving entire satisfaction. From time to time numerous alterations have been introduced in the appliances employed in the production of Portland cement, but up to a very recent date, so unimportant have these changes been, that their value would be exaggerated if they were called improvements. A striking contrast to this normal state of affairs has, however, lately presented itself; alterations are being made highly beneficial to the manufacturer, and consequently advantageous to the consumer and the public. Recently more than one specification has been sealed at the Patent Office, under the heading of "Improvements in the Manufacture of Portland Cement," and not the least important of these is the chamber system, invented by Mr. Isaac Charles Johnson.

When alterations are made, and new appliances are introduced in the process of manufacture, the adoption of which results in the economy of fuel and labour, as well as greatly diminished space requisite for manipulation, the advantage gained by the manufacture must be considerable; but, if these economical changes or improvements can at the same time ensure higher perfection in the quality of the finished manufacture, the value of those appliances cannot be over-estimated. The chamber system possesses all these qualifications to a singular degree, as the following attempt at explanation will show.

It is agreed by all who have had an opportunity of giving any attention to the art and science of Portland cement making, that one of the most important points in the manufacture is the proper mixing of the crude materials. This process of amalgamation is usually accomplished by the agency of water in the wash-mill. After the particles of the materials have been thoroughly incorporated, the aggregate, or "washed stuff," is pumped into large reservoirs, there to undergo the process of settlement, in order that the surplus amount of water, requisite for the proper amalgamation in the wash-mill, be drawn off, by that means bringing the washed material into a state preparatory to the drying process. This process of settlement, which requires at least three to four weeks, is attended with many serious disadvantages, especially when this settling occupies some months, which is often the case where the area of land available is limited, rendering deep reservoirs a necessity.

However perfect the appliances employed for the complete and thorough incorporation of the materials in the wash-mill are, the process being purely mechanical, the intimate connection that one particle bears with another is only temporary, because the two principal components—carbonate of lime and silicate of alumina—differ considerably in their specific gravities; consequently, the careful manufacturer has frequently to resort to means and appliances both tedious and expensive, with the view of restoring the mixture to its original proportions, after settlement, before subjecting the material to the next process of drying. Johnson's chamber system provides that these objections are entirely obviated. The washed material is pumped direct from the mills into a horizontal flue or chamber, through which the waste heat given off from the kilns passes; the effect of this heat renders the fluid material a solidified mass in a few hours, thereby preventing any possibility of unequal subsidence, as is the case in the open reservoirs.

Unequal calcination during the process of burning has always been a cause of annoyance and expense to the cement manufacturer. An unusual disturbance in the atmosphere causing an excess of draught, a slight deviation on the part of the burner in the quantity of fuel employed for the proper calcination of the cement, the ever varying proportion of combustible power contained in the fuel, are all difficulties liable to present themselves when the now old-fashioned open-topped kiln is in use. The chamber kiln is fitted with a complete system of dampers, thereby placing under control the augmentation or reduction of draught, as circumstances may require, so as to produce well-burned cement, and enabling the burner to calculate the minimum quantity of fuel necessary, with an accuracy hitherto unknown in cement making.

When a process of manufacture occupies a few days, which has formerly required as many months, it is obvious the saving in capital must be very considerable; therefore, financially, a boon to the manufacturer; but the consumer reaps special benefits from a process of rapid manufacture, inasmuch as it gives the cement maker a better opportunity of controlling

the many variations that continually occur during the process of manufacture, thereby enabling him to guarantee, with more confidence and greater certainty, the suitability of his cement to the purpose for which the consumer requires it.

In addition to these many advantages gained by the adoption of the chamber system, there are several other recommendations which, although not directly affecting the consumer, are of such importance to the cement maker, that, in an indirect way, the purchaser must reap a certain amount of benefit.

The immense economy attained by dispensing with the drying stones and their necessary belongings, the wear and tear of which, and continual repairs, form a very considerable item in the charges account of a cement manufactory, is one of the many benefits derived by adopting the now popular chamber kilns.

Although this system is comparatively in its infancy, eight different cement makers, manufacturing a total per annum of not less than 90,000 tons entirely by chamber kilns, is a significant proof that the arguments just put forth are not alone based on theory, but substantiated by a wide practical experience.

Another improvement of scarcely less importance than Johnson's chamber system, has also recently established for itself a reputation, clearly proving its value in cement making by its extensive adoption.

Goreham's patent process of washing, as far as the consumer of Portland cement is concerned, carries with it the same recommendation as the chamber system, in that its adoption by the manufacturer undoubtedly tends to improve the quality of his cement. As mentioned before, it is an old-established fact that one of the most essential points in the manufacture of Portland cement is the proper mixing of the crude materials. By proper mixing is understood, the right apportionment of these materials in the mill; the reduction of the particles of each compound to the utmost degree of fineness that is attainable, and their intimate and thorough amalgamation, so as to prevent, as far as practicable, their being again separated.

In the system of washing hitherto adopted, it has been considered necessary, in order to ensure the thorough amalgamation, that the materials must be diluted with not less than three to four times their weight of water. As this large amount of water requires to be drawn off again, through the agency of the subsiding ponds, or by evaporation when the patent chamber kiln is employed, it is obvious that any system which will ensure satisfactory results, and, at the same time, will allow the manipulator to dispense with a large proportion of this water, is very valuable. Goreham's system possesses this advantage. Mr. Goreham subjects the materials to a process of wet grinding, which, to a certain extent, takes the place of washing. The chalk and clay are thrown together in the right proportions into a mill fitted exactly similar to the present wash-mills; but instead of being reduced to a liquid with the usual large proportion of water, they are brought, by the addition of only one-third their weight of water, to a consistency just thin enough to flow out of the mill. But as this mixture contains a large proportion of coarse particles of the aggregates, which require further reduction, the mixture is passed through horizontal millstones. By this process the particles are speedily reduced to an impalpable paste, of a fineness unattainable by the ordinary process of washing, and the mixture is of sufficient **solidity** as to render the intermediate process of settlement unnecessary, the **slip** or paste being pumped direct to the drying stones or chambers, thus avoiding the possibility of any separation of the component parts.

Although Johnson's chamber system possesses the like advantage of dispensing altogether with the settling-ponds, it has been proved by experience that occasionally a small extra per centage of fuel is necessary in the chamber kiln to evaporate the large proportion of water contained in the "washed stuff" when prepared by the ordinary method in the wash-mill. Experience has likewise demonstrated that when the stuff is supplied to the patent chambers from Goreham's wet grinding mill, a considerably less amount of fuel is required for the calcining and drying of the material than by any other process that has yet been employed in cement making.

It is an extraordinary and happy occurrence that two distinct processes of such vast importance to the cement manufacturer should be brought forth and presented to the world almost simultaneously, the combined working of which (although both are in a state of comparative infancy) are even now producing results far exceeding the expectations of the most sanguine.

In order that you may more accurately estimate the advantages gained, so far as the quality of the cement is concerned, it is, perhaps, advisable to endeavour to explain in a more lucid manner why Portland cement, which has been subjected to the processes just mentioned, must of necessity take precedence in the testing-room over cement manufactured by the old-fashioned system.

Competent judges are all agreed that slow-setting, heavy, well-burned, finely-ground cement is undoubtedly the best. In order to arrive at the qualifications of "slow-setting" and "heavy" the manufacturer must regulate the mixture in the wash-mill, so as to use a maximum proportion of chalk. If the mechanical mixing in this first stage of manufacture has been so complete as to accomplish a perfect amalgamation, the result will be satisfactory; but if the mixing has in the smallest degree been incomplete, the attempt to produce slow-setting and heavy cement will prove to be a disastrous failure, an article containing an excess of free lime will be produced, which will necessarily blow when used, causing a general expansion of the work, the fatal consequences of which need not be referred to. Hence the advantage of adopting a process by which a complete amalgamation is secured.

Again, cement that is not well burned possesses the same serious tendency to expand. It is true that in most manufactories where the open-topped kilns are in use, care is taken that the under-burned cement is separated from the well-calcined clinker; but prevention is better than cure.

Lastly, cement which is over-burned assumes a flinty metallic-like nature as clinker in the kiln, most difficult to pulverize, and useless for producing cement possessing the element of being finely ground. It must, therefore, be obvious that a system which can assist to perfect the calcination will be an important stepping-stone towards attaining those last-mentioned qualifications of well-burned and finely-ground cement.

With these explanations, I have more confidence in having trespassed on the valuable time of the Members of this important Association, to present to their notice improvements in the manufacture of an article now occupying so prominent a position in gas engineering; and when the fact is established that manufacturers are now introducing plans and adopting appliances which will increase to a very considerable extent the hardness, hydraulicity, and durability of Portland cement, I am sanguine that the patronage which gas engineers have already conferred on cement will increase to such an extent as will not bear comparison with the past, especially when I inform you that in adopting the patents I have just referred to it is necessary that the manufacturer should purchase all the fuel required in the shape of coke, which is not the case in the old-fashioned method of cement making; and I may mention that experiments and experience have taught me that good gas coke is the best description of fuel that a cement manufacturer can adopt.

Mr. R. SMITH (Darlington) read the next paper, which was

ON CONDENSATION.

In the early history of gas lighting we read but little about condensation, although it was then, as it is now, an essentiality of gas manufacture. From the time gas was first used for artificial lighting until now, many forms of condensing apparatus have been devised, and many alterations and improvements have been made; but I do not think even yet that this particular part of purification has received the amount of attention that it deserves. It has often been asserted that "good condensation is half purification." Well, it may not be quite half purification, although it plays a very prominent part in the process of gas manufacture, and is worthy of receiving that amount of attention which it does not receive. Certainly, in the process of condensation, the gas is not cleansed of the sulphuretted hydrogen or the sulphur compounds, condensation being a mechanical operation, but it is separated from the tarry and watery vapours which it contains, and reduced to that temperature which makes the other processes of purification more easy. If by imperfect condensation and cleansing the gas from tarry and watery vapours, as by imperfect purification from sulphuretted hydrogen, the gas was sent impure to the consumers, a much greater interest would be taken in it; still if, by imperfect condensation, gas containing sulphuretted hydrogen is not sent to the consumers, but tends to decrease the prosperity of a gas concern, is it not as much our duty to favour the employer as to favour the consumer, and does it not bring with it a greater amount of satisfaction to ourselves? Condensation is the first process of purification, and if it be defective, the other processes will be defective, because they are directly and indirectly connected with, and influenced by it. The question now arises: What is good condensation, and how is it to be arrived at, and what advantages arise, from having a sufficient and proper arrangement of condensing apparatus? I do not purpose entering very fully into this subject, but I trust the few remarks I do make will not be devoid of interest.

The tarry and watery vapours present in the crude gas will condense somewhere, and where can this be better done than in the apparatus constructed for that purpose; but if it be insufficient or incapable of doing so, the scrubbers or washers, purifiers, and street-mains will become condensers, which certainly is anything but pleasant or profitable. The condensers are intended to cool the gas to a certain temperature, and cleanse it from the tarry and watery vapours which it contains in its crude state, and, to perform this work thoroughly and well, they must be of sufficient capacity and construction so as to reduce the gas to its lowest temperature, and at the same time remove these impurities before the gas has issued from them. If condensers cannot perform this work, it is a waste of money in having them erected at all. It is estimated that the temperature of coal gas in the retort does not exceed 135°, and this must be gradually and regularly reduced. The gas in the first and second columns of the condensers is often reduced about 25°, whereas the remaining columns, six in number, will not reduce it 20°. There is no regularity about this, and I would suggest that the columns be regulated to make—or as nearly as possible to make—the reduction at this ratio, viz.:—

Gas enters at, say—	First Column.	Second Column.	Third Column.	Fourth Column.	Fifth Column.	Sixth Column.	Seventh Column.	Eighth Column.
100°	96°	90°	83°	72°	62°	55°	51°	49°

The lowest temperature to which the gas is exposed will be rather under 49°, but it is better to be under than over condensed, because in the latter case there is danger of depositing the hydrocarbons, and, consequently, damaging the illuminating power; also danger of depositing naphthaline in the main and service pipes; and how often are the inlets and outlets of our gasholders choked up by this naphthaline, or "salts," as it is generally called.

It is a very difficult matter to have condensation perfect, because of the great irregularity in the quantity of gas manufactured, and the variation of the atmospheric temperature, but I believe it might be a great deal nearer perfection than it presently is, and the nearer it is to perfection, the better will be the result financially.

A great many different arrangements are put forward, by their own advocates, as being competent to perform this task of condensation efficiently.

We have, for instance, the battery condenser, the underground condenser, the horizontal condenser, the annular condenser, and the water channel condenser. The last two mentioned are looked upon with more favour than the others. In the water channel condenser, I believe that the gas is cooled too quickly—that is, if the water can always be kept cold. Hughes says: "Where the gas has an excess of temperature of 10° over the atmosphere, a unit of surface which would radiate eight parts of heat in the open air, would, in water, radiate no less than 88 parts," or "where the gas has an excess of 30° over the atmosphere, a unit of surface which would radiate 29 parts of heat in the open air, would, when plunged in water, radiate no less than 5358 parts of heat." This certainly shows the superiority of water as a cooling medium, but I believe that gas is not wanted to be cooled in such a hurried manner, and on this account I do not think that the water channel arrangement of condensation will ever attain a great standing as a condensing medium, and more than this, no matter how the water may be regulated, and put in or drawn off the cistern that contains the piping, no matter how many division-plates are fixed to regulate the flow of water against the flow of gas, the temperature will not be reduced proportionately, and it is impossible, under such circumstances, that good condensation can be effected.

The annular condenser has attained a greater standard than the water channel condenser—indeed, than all other condensing arrangements—although I believe it is deficient, because the current of air is equal in the inlet column to that of the outlet column; the result being that the gas is lowered too quickly in the first column, and reduced to its lowest temperature not proportionately. I believe it would add to the efficiency of this condensing arrangement if the first and second columns had no inner cylinder, or if the current of air was regulated at the top or bottom of each column, and this could easily be arrived at by placing small doors or covers of such construction that they would act as dampers, and so regulate the draught as necessitated by the temperature of the gas and atmosphere. A thermometer would be required for each, or every alternate column; but the process of cooling and cleansing the gas from the tarry and watery vapours would go on smoothly, regularly, and efficiently. This condensing apparatus is subject, like other condensing arrangements, to become choked with tar and sulphates, unless there be some preventive, and it is rather awkward getting them cleaned out, especially in the winter months; and when there is no bye-pass, and while they are being repaired, the gas passes onward to the scrubbers and the purifiers without being condensed at all. Now, it is a very easy matter to have a steam-pipe

connected to the end of every fourth or fifth column; open the tap occasionally, the steam is carried along with the gas; the temperature of the interior of each column is raised, say, 30° over the ordinary temperature, and the tar and sulphates are deposited in the bottom box. We have this arrangement in Darlington, and are never put to inconvenience by foul condensers, and have always the same area of cooling surface. I am aware that a number of Managers have adopted this system of cleansing by steam; but a good thing is none the worse for being told over again, and, perhaps, there may be a few who have not considered the advantages of it, and I believe that, when a condensing column has an internal coating of one inch, its action is greatly impaired, and, if it be allowed to grow much over that thickness, it is a condenser in name only, not in action, because the gas is robbed of the cooling influence of the atmosphere.

A great difference of opinion seems to prevail as to what quantity of surface is necessary for the proper condensation of gas; but it is generally considered that 150 square feet of surface is required for every 1000 cubic feet of gas manufactured per hour. I do not consider this a good criterion, or a rule to be depended upon, because a great deal depends upon what kind of apparatus is employed, how it is worked, as well as the atmospheric temperature, and much also depends on the temperature of the retort, the position of the hydraulic main, and the length of piping through which the gas passes before entering into the condenser. Another consideration is the coal that we use. Clegg says: "Some kinds of coal require greater condensing power than others. The coals from the Midland Counties, for instance, yield twice the quantity of aqueous vapour that Newcastle coal produces during distillation." So we may be satisfied that it matters little how many feet of surface we have to bring the gas in contact with; if it be not properly applied, good condensation cannot be effected. If the cooling influence in the first column is as great as in the last column, how can the gas be properly cooled and condensed? If the gas issues from the last column of the condenser at a higher temperature than that to which it will be exposed, or if it issues from the last column at a temperature of, say, 65°, and enters into the first scrubber or washer, which shows 60°, how can the gas be properly cooled and condensed? Consequently, the scrubbers are unable to perform their part of the purification, because the gas does not enter into them properly cooled; and if not properly cooled, not properly condensed from the tarry and watery vapours, and the purification of ammonia is impaired. If the gas enters the purifiers at an excess of temperature, the lime also loses its affinity for removing the carbonic acid, and we know that carbonic acid gas is not only uninflammable, but it instantly extinguishes flame even when diluted with three times its volume of air; so it is essentially necessary that this impurity should be at least partly removed from the gas, and we know, from various authorities, that its presence, only to the extent of one per cent., will diminish the illuminating power of coal gas fully 5 cent.; and, more than this, if the purifying lime is made hot by the gas, it very soon becomes hardened up, and requires to be taken out before being fully saturated with sulphuretted hydrogen; otherwise, keep on working for a day or two against a crushing back pressure. But even taking it for granted that 150 feet of surface is sufficient, when properly applied, we must have the condensing apparatus divided by valves, so that in the summer months, when the make of gas is at its minimum, the gas will not pass through all the columns, but have only, or as near as possible, the same area of 150 feet; although I believe that, in any case, it is advantageous to have the condensing apparatus divided, so that we can have more or less cooling surface as necessitated by the variation of circumstances under which we labour.

The principal—in fact, the only argument, advanced in favour of underground condensation is that, by keeping the gas in contact with the tar, the illuminating power would be increased; but if this does increase the illuminating power, it could be equally well performed by placing pipes along the interior of the retort-house wall, where the temperature is nearly always equal, and where tar will always be found in the pipes, and at a temperature that would not condense the hydrocarbons, which, however, would be the case, and especially at the end pipes of the underground condenser. It has been asserted that while the temperature of gas is being reduced from 120° to 110°, it is enriched with the volatile oils contained in the tar, but if it be kept in contact with the tar after this, and while being further reduced in temperature, those oils drop off or are condensed.

From this we can infer that the retort-house piping is a capital system of condensation, and much superior to the underground condenser, so far as keeping the gas in contact with the tar, as a means of increasing the illuminating power, is concerned, because where the one is defective the other is efficient—that is to say, tar at every temperature will not give off the volatile oils, and while it would give them off in the retort-house piping, it would not in the underground condenser.

Of one thing, however, we are satisfied, and that is, that the tar should not be carried any further than the condenser, because, if it is, in addition to decreasing the illuminating power, it will gradually close the gas passage in the scrubbers or washers, and tar having an affinity for naphthaline, a total stoppage will naturally follow, and the apparatus require to be put out of use, and, perhaps, when it can be least spared; certainly, if a current of water or ammoniacal liquor is kept constantly flowing through these vessels, the tar and naphthaline may not be deposited there, but especially in small works, water or ammoniacal liquor is seldom passed through the scrubbers. Mr. R. H. Patterson, ex-gas referee, speaking on this subject, says "One disadvantage of tarry matter being allowed to pass forward from the condenser is that the tar chokes up the interstices in the coke or brick scrubber, so that the gas, instead of ascending equally through all parts of those scrubbers, forces a passage upwards by comparatively few routes, and thereby does not come in a proper manner in contact with the purifying water." Also, "The water or liquid in the scrubbers is raised above the ordinary temperature, whereby its power of absorbing ammonia is lessened, while at the same time the liquor from the scrubber, gives off into the air, a larger portion of the ammonia which it contains than it would do at a lower temperature."

From this we can infer that if the ammoniacal liquor is made warm by the gas not being properly or sufficiently cooled in the condenser, its power of absorbing ammonia is lessened, and the gas goes to the consumers containing that impurity. It may or it may not be detected, but one result is certain, and that is, the brasswork of some hundreds, perhaps thousands of meters, and the fittings of dwelling-houses, are being eaten up. While this is taking place outside, the apparatus inside is foul and there is little or no gas passage. The engine and exhauster are battling with a heavy back pressure, which means a greater consumption of fuel; the rich illuminants are being partly deposited, a less quantity of gas is obtained from a given quantity of coal, and, as a matter of result, bad returns. So if good condensation is not half purification, it certainly plays a very prominent part in the half-yearly balance-sheet. If inefficient condensation bring with it such serious results, is this subject which I have taken up not worthy of receiving more attention in the future than it has received in the past?

Some discussion followed at the close of Mr. Smith's paper, in the course of which Mr. Nelson (Glasgow) described a process of gas purification proposed by Mr. Steel, the inventor of the Steel and M'Innes Railway Brake, which was intended to serve for all the three purposes of condensing, scrubbing, and purifying coal gas.

Hearty votes of thanks were passed to the several gentlemen who had favoured the meeting with addresses, and also to Mr. Donaldson, of Edinburgh, for his exhibition of the Foulis Governor and Lamplighter, both of which were at work in the room.

At the close of the meeting, the CHAIRMAN announced that the following officers were elected for the ensuing year:—

President—Mr. J. Hepworth, Carlisle.
Vice-President—Mr. William Ford, Stockton-on-Tees.
Secretary and Treasurer—Mr. William Hardie, Newcastle.
Auditor—Mr. John Booth, Middlesbrough.
Committee—Messrs. J. H. Cox, Sunderland; Charles Sellers, York; Thomas Trewhitt, West Hartlepool; and William Smith, Darlington.

The Members of the Association, with their friends, dined in the afternoon at the Crown Hotel. The President (Mr. W. J. Warner) occupied the chair, and the vice-chair was ably filled by Mr. J. Hepworth (Carlisle). The usual loyal toasts having been duly honoured,

The CHAIRMAN proposed "The Army, Navy, and Reserve Forces," coupling with the toast the names of the Mayor of Middlesbrough (Colonel Sadler), and Colonel Cowen of Blaydon.

Both gentlemen having responded,

Colonel COWEN proposed "Success to the North of England Gas Managers Association," and, in doing so, said it had given him great pleasure to be present at the meeting that day, and participate in the knowledge that had been disseminated amongst them. The Association was in a most satisfactory state, and he felt sure that it would be a worthy co-operator with the parent society. He certainly looked to it in this light—that it would be one of the feeders of the great river, the great output of the whole, and he trusted that whether there might be another society in the west, east, or south of England, they would all be tributaries to the one great source. They were perfectly justified in having a minor institute in the North of England, and he was pleased they had so substantial a one formed. He trusted that the influence already disseminated amongst the Gas Managers in this district would extend still further, and include the whole of the northern counties in the infant Association. They had the opportunity of hearing papers read, and no doubt they would be of substantial interest to those connected with the manufacture of gas. Coupled with the toast, he gave the health of Mr. Warner, and expressed the hope that the Association might long have the pleasure of that gentleman's good counsel, his friendship, and his knowledge at their meetings.

The PRESIDENT responded.

The VICE-CHAIRMAN gave "Kindred Associations." He hoped the day would come when the whole of the districts in the North of England would be covered by Associations of this kind. They were conducive not only to pleasurable intercourse, but also to profitable intercourse with respect to all matters connected with their own branch of science. With the toast he coupled the name of Mr. Nelson.

Mr. NELSON (Glasgow) having responded,

The healths of the Vice-Chairman, and of the Secretary (Mr. W. Hardie) were drunk. Other toasts were also proposed, and the proceedings then terminated.

COLNE (LANCS) GAS COMPANY.—At the last meeting of Shareholders, on the 7th inst., a resolution was passed expressing unqualified satisfaction with the way in which the affairs of the Company have been conducted by their chief officers—Mr. Thomas Varley, the Manager, and Mr. C. Tatham, the Secretary. A sum of £50 was also voted to each of these gentlemen as a testimonial of the appreciation in which their services are held by the Directors and Shareholders.

ROTHERHAM AND ITS ENGINEERING TROUBLES.—A "noiseless" gas-engine recently made considerable noise in the Sheffield County Court. Though probably silent itself, it was the cause of much speaking on several days by the gentlemen of the long robe. The neighbouring town of Rotherham has not been troubled with an affliction of this sort; but it has also had its own ills to bear, and not the least of these has been a gas-tank. At various times since the incorporation of the borough—for Rotherham is as yet a juvenile among the corporate bodies of the country—the Gas Committee of the Town Council have discussed the desirability of providing themselves with a Consulting Engineer. Some time ago the Corporation decided to extend the gas-works, and amongst other undertakings they have constructed a new purifying-house and a large gas-tank. During the heavy rains, about the beginning of last year, a wall of the purifying-house fell into the river, and the great gale at the close of the year demolished the roof of the same unlucky building. As if these misfortunes were not sufficient, it was subsequently discovered that the new tank would not hold water. The "accidents" induced the Gas Committee to renew their discussion about the Engineer. As the wind blew and the rain beat about that house—that purifying-house—it struck them more forcibly than before that they could do with professional advice; and when they found their new tank failing in its mission, which was distinctly to hold water, that impression was deepened upon all their minds. Mr. John Depledge, of Sheffield, was accordingly appointed the Consulting Engineer, at a salary of £100, which was certainly not an extravagant remuneration. His first bit of work was to prepare a plan for the repair of the tank. He did so, and obtained a contract for the work to be done according to a schedule of prices. He estimated the cost at £1300. This was considered a somewhat elaborate plan. It included pile-driving and other expensive operations. The Committee met last February to consider the plan. The result of their deliberations was a recommendation that the Council should adopt it. That body met in March, and honoured the scheme with a prolonged discussion, during which it was stated that Mr. Goodwin, the Gas Manager, had also a plan, and that Mr. Goodwin was prepared to give guarantees that his ideas could be carried out for £400. The Rotherham Corporation are only human, and when the Members were gravely told that what they wanted could be done for £400 instead of £1300, they resolved, by a majority of one, to refer the matter back to the Gas Committee for further consideration. That Committee met in March, and, by the Chairman's casting vote, they adopted the £400 plan. Their recommendation was considered by the Council at their April meeting, when, by another majority of one, making the third occasion when that all-powerful "one" had prevailed, they threw over the £400 plan, and fell back on the £1300! Here, perhaps, the reader supposes the matter rests? Not a bit of it. The Corporation, having evidently qualms of conscience on the score, subsequently came to the unanimous decision again to refer the matter back to the Committee for further consideration! Once more the Members of the Committee met. This time it was a special meeting, at which Mr. Depledge and Mr. Goodwin agreed to jointly prepare a plan for carrying out the work. Thus stands the "situation." At this rate of progress, it may be fairly anticipated that by the time the tank and purifying-house are put to rights, Rotherham will be in a fair way to know how to do without both of them.—*Engineer.*

WEST OF SCOTLAND ASSOCIATION OF GAS MANAGERS.

The Sixth Annual Meeting of this Association was held on Thursday, April 25, in the large room of the Public Museum, Paisley. There was a large attendance of members. Mr. JAMES M'GILCHRIST (Dumbarton) President of the Association, occupied the chair.

ADOPTION OF MINUTES, ETC.

The SECRETARY (Mr. R. S. Carlow, Port Glasgow) read the minutes of the various meetings which had been held by the Committee of the Association since the previous half-yearly meeting at Helensburgh.

The PRESIDENT, in moving the adoption of these minutes, said: I beg to call special attention to the low state of the funds, which, in a great measure, results from the non-payment of subscriptions by gentlemen whose names are on the roll as Members of the Association. In the course of to-day's proceedings, a motion dealing with this unsatisfactory state of affairs will be proposed for the acceptance of the meeting. This is a state of matters that we must get rectified. It is useless to have Members on the roll if they will not pay for their connection with the Association. I have also to state that, at a Committee meeting held this morning, it was unanimously agreed to ask you to confer the distinction of honorary membership upon Mr. Hislop, of Paisley, who has done everything in his power to make this meeting a success, and I need scarcely add that, so far, he has been very successful.

The minutes were adopted, and the proposal of the Chairman was cordially adopted.

Mr. HISLOP: I have to thank you for the honour you have conferred upon me in electing me to the position of an Honorary Member of your Association. I appreciate and value this kindness very much, I can assure you; and if I have done anything in the way of contributing to the success of this meeting, I shall be happy; and if anything I can do will contribute to the further success of the meeting, I will willingly place my services at your disposal.

ELECTION OF OFFICE-BEARERS.

The PRESIDENT: The Committee have to-day drawn up a list of office-bearers for the ensuing year, which I beg to submit to the meeting. Of course, any Member has the right to propose any gentleman he thinks proper. The proposed office-bearers are as follows:—

President—Mr. Samuel Stewart, Greenock.
Vice-President—Mr. William Young, Clippens.
Secretary—Mr. R. S. Carlow, Port Glasgow.
Treasurer—Mr. W. Smith.
Committee—Messrs. D. Jeffrey, W. Fairweather, Levi Monk, R. Mitchell, James M'Gilchrist, John Fleming, S. Dalziel, and James Renfrew.

These gentlemen were unanimously appointed.

The PRESIDENT said: Mr. L. Hislop, Uddingston, retires from the office of Auditor, held by him for two years. The other Auditor is Mr. John Walker, Ayr, who continues in office for another year.

On the motion of Mr. RENFREW, Mr. Samuel Black, Alexandria, was appointed in room of Mr. Hislop.

ADMISSION OF NEW MEMBERS.

The SECRETARY submitted the following list of

Extraordinary Members.

Andrew Spencer . .	Coal Merchant,	Glasgow.
John Wilkie . . .	Lime Merchant,	Greenock.
Joseph Gilmour . .	Bonyton Fire-clay Works,	Kilmarnock.
R. M. Sutherland . .	Manager, Chemical Works,	Falkirk.
Wm. Donald, jun. .	Abbey Works,	Paisley.

Ordinary Members.

John Davidson . .	Dawsholm Gas-Works,	Glasgow.
James Robb	Gas Manager,	Ayr.
Charles Reilly . . .	,,	Strabane.
John F. Macfarlane .	,,	Stornoway.

On the motion of the PRESIDENT, seconded by Mr. RENFREW, these gentlemen were unanimously elected.

ARREARS OF SUBSCRIPTIONS.

Mr. MITCHELL (Coatbridge): The matter of arrears is a subject which has been a cause for regret in Associations other than the West of Scotland, and it is a subject which the Committee have deemed it their duty to set a strong face against. I take upon myself the liberty of proposing that a Committee be appointed, with full powers, to draw up a list of arrears, and that the Committee shall have full powers to strike off the roll of membership those parties who are two years in arrears with their subscriptions.

Mr. FULLERTON (Motherwell) seconded the motion.

The PRESIDENT: By the rules this motion can only come into operation after the next annual meeting.

Mr. NIVEN (Dunoon): It is a great pity that any Members should be in arrear with their subscriptions; but perhaps the subscriptions may be too high. Considering the advantages which are derived from connection with an Association like this, I think all Members ought promptly and willingly to pay their subscriptions. It should, however, be remembered that most of the Members are "wee" Managers, with perhaps very limited incomes. In such cases I think the amount of subscriptions might be reduced. I think it would be unwise to eliminate a number of the defaulters, because it would make the Association more select, and in that way it would subvert, to a certain extent, the proposed object of the Association.

The PRESIDENT: We are indebted to Mr. Niven for the suggestion, and if it were the fact that the "wee" Managers are in arrear, there might be some force in what Mr. Niven has said; but the fact is that it is mostly those in good positions who are in arrear. With regard to the amount of subscription, this Association charges less than any that has yet been established—that is, considering the amount of work that it accomplishes. The annual report on the gas supply of Scotland is in itself a great expense, which other and kindred Associations do not incur, and comparing ourselves with the North British, the parent Association, we have a benevolent-fund to support, which they have not. Instead of the subscriptions being reduced, they ought to be increased, in order to meet the increasing demands which are being made upon us year after year, to have more efficient reports. But the Committee will consider Mr. Niven's valuable suggestion, and bring it up with the report which they will submit to the next annual meeting.

Mr. MITCHELL: I should like that special powers should be given to the Committee in regard to these arrears. I do not think that it is right the Secretary, who has other duties of a heavy kind, should be troubled in the future as he has been in the past, in writing letters to people who never reply.

Mr. FAIRWEATHER: I think there should be a rule to this effect, that, in cases where payment is not made within a limited time, the party should cease to be a Member after due notice being given.

The PRESIDENT: The Committee propose to bring some such recommendation before the next meeting.

PRESIDENT'S VALEDICTORY ADDRESS.

The PRESIDENT then delivered the following Valedictory Address:—

Gentlemen,—I have great pleasure in meeting you all, after the labour of another winter, for mutual improvement on subjects connected with gas lighting, at this the sixth annual meeting of this Association, and the first Gas Managers meeting ever held in this town, which is famous for many arts, including gas engineering. It also affords me much pleasure to state that during the year now numbered with the past your Committee are not aware of a single instance wherein the Association's efficiency was impaired by death. During the same period there has been no demand for aid from the benevolent-fund. Gentlemen, these are pleasant conditions, which few Associations with a like membership enjoy, and the facts mentioned say much for the general health and prosperity of the members.

The Association may be compared to the science of gas lighting, inasmuch as it is always progressing. To-day, we have a number of extraordinary and ordinary members admitted, giving us a grand total of over 200 members. I agree with your Committee, that the connection members have with this Association should be severed, and pass into history, whenever they allow themselves to run more than two years in arrears. If an Association is worth being connected with, it should be regularly supported.

Prize Paper.

The Sub-Committee appointed to award Messrs. A. and J. Stewart's £10 prize for the best paper on "The Most Economical Mode of Manufacturing Gas from Coal or Shale to Produce an Illuminating Power of from 25 to 30 Candles" consider it right to allow the summer rather than the winter time for the preparation of papers. Managers who have forwarded papers can amend them, should they think fit. The date when all intending competitors must remit their papers to the Secretary will be duly advertised in the JOURNAL OF GAS LIGHTING. I trust the papers will be numerous, and worthy the liberality of the donors.

Annual Report on the Gas Supply of Scotland.

Your last report on the gas supply of Scotland is, I believe, the most complete published. It is gratifying and encouraging to know that many, if not all, the Gas Managers who opposed the report on its introduction, a few years ago, are now cognizant of its great utility, and readily subscribe the important information it contains. "Every art is improved by emulation." Ours, being no exception to the rule, is greatly improved by the emulative spirit the report engenders among Managers. I will now venture to occupy your time and attention with remarks suggested by a few columns of the report.

Carbonization.

To secure efficiency and economy in the carbonizing department, there should be at least from 15 to 20 per cent. more retort power than is required to produce the maximum daily make. One of the advantages of this is that retorts can be worked until it is prudent to let them out, whereas, with limited carbonizing surface, used, but often good, retorts have to be pulled out at the beginning of a winter, lest they might break down about the season of the maximum daily make, when they cannot be dispensed with, and when there are no others to fall back upon. To prevent this loss, and gain numerous other advantages, considerable additions will require to be made to the benches of many a retort-house in Scotland.

Many great improvements have been made in the setting, heating, and working of horizontal retorts since the time our great countryman—Murdoch—applied coal gas to useful purposes, and ingenious machines have been constructed for charging and drawing them; but, unfortunately, they can only be economically employed in large works.

Gravity, the cheapest force in nature, has not been so extensively applied to the carbonization of coal as, in my opinion, it ought to. It enables the oil manufacturer to carbonize fully twice the quantity per man that we accomplish with our horizontal settings, in the ordinary way of working. At the Dumfries meeting of this Association, our worthy member, Mr. Andrew Scott, placed before us a vertical setting of retorts, which, in my opinion, contains all the conditions essential to the perfect carbonization of coal in the manufacture of gas. In this vertical setting, the heated coke of the previous charge is made to carry on the carbonization of the non-gasified products of the fresh charge, while, at the same time, poorer gases are produced by the decomposition of water, which add very considerably to the quantity and quality of the gas, by picking up the surplus hydrocarbons that flow in our present system to the tar-well, to contribute fortunes to the tar distiller. The vertical has another great advantage over the horizontal setting, in being so well adapted for the introduction of gravity to work them economically.

Pressure on Retorts.

The fifth column of report shows the pressure on retorts to vary from ¼ inch to 13 inches. I have no hesitation in stating that any works with anything like a dozen inches of pressure on the retort must be working at a great loss, for it is an undisputed fact, that the greater the pressure on a retort, the greater will the crop of carbon be, which not only robs the gas of its principal illuminant, but greatly retards the proper carbonization of the coal. Anti-dips prevent, to a great extent, this troublesome deposit, by reducing the pressure due to the seal, and abolishing the pulsations it produces, which Mr. Young has shown to be the principal cause of excessive depositions in highly heated retorts. Unfortunately most of the anti-dips are so liable to cause accidents, through not being self-acting, that Managers generally "rather bear the ills they have than fly to others that they know not of." I would strongly recommend for your careful perusal an able paper by Mr. Forstall, of New Orleans, read before the American Gaslight Association, "On the Advantage of Removing the Hydraulic Seal during the Distillation of Coal." It appeared in the *American Gaslight Journal* of Nov. 2, 1877, and is elaborated on data obtained from long and careful experiments, which ably support the following conclusions:—

1. With equal heats, from equal weights of coal, little or no increase of gas is obtained by the removal of the hydraulic seal, unless a vacuum is maintained in the retorts; in which case the increase is not from the coal, but from the furnace; and the loss of illuminating power overbalances the gain in volume.

2. The removal of the seal prevents effectually the excessive deposition of carbon caused by over-decomposition of the gas, and thus improves its illuminating power.

3. With an equal daily production of gas, the durability of clay retorts is nearly doubled by the removal of the seal, provided a slight pressure be steadily maintained within them during the process of distillation.

A physician must know a patient's trouble before he can properly apply medicines to effect a cure. In like manner we, knowing the bad effects of the dip, and the dangers of the anti-dips, anticipate a remedy in an apparatus that will automatically maintain a steady pressure of say one inch in the retort, and at the same time prevent pulsations. With a view to accomplish this, Mr. Young, of Clippens, has recently invented and patented a dip, which takes advantage of the pressure necessary to automatically produce a seal, to effect the precipitation of the tarry and sooty matter from the crude gases, at a high temperature, as they enter the hydraulic main, in a continuous stream, and free from any pulsatory action. Should practice prove this dip to perform its varied and important duties satisfactorily—and of that I am sanguine—it will be a most useful addition to our plant, and a step towards the perfection of a process of the utmost importance to us all.

Condensation.

The condensation columns, area, and capacity, indicate that no hard and fast line is accepted to effect the condensation of our crude gases. The annular condenser is, perhaps, the most popular. Its only advantage over the other ordinary forms is that it looks a little better, or is a trifle cheaper. Its principle of cooling the gases is identical with the others, and, consequently, of much the same value as a condenser. Our knowledge of condensation is now directing us towards separating the crude gases from the tars at high temperatures, because we know the tars have then no affinity for the hydrocarbon vapours, which they absorb and carry to the tar-well at low temperatures, as they do in the ordinary forms of condensers. The only condenser that takes advantage of this knowledge, is the Aitken and Young "Analyzer," which this Association had the honour of introducing to the gas world. Dr. Wallace, one of our most eminent chemists and gas examiners, has tested it, and declares it "an immense step in advance of anything we have had before." The tar distillers also give it an excellent testimonial for denuding the tars of the naphtha vapours, by refusing to purchase them. There is a feeling among Gas Managers generally that it is the best condenser we have yet had; but it is not, and I fear will not be, generally adopted until the patentees will guarantee a price for the tars that will, when carefully calculated, leave a fair margin of profit for diffusing the naphthas through the gas, instead of the tars. Mr. Aitken, of Falkirk, is to honour us to-day with a paper "On the Influence of Aqueous and other Vapours on Illuminating Gas." You will have observed, in the JOURNAL OF GAS LIGHTING, many able letters by M. Brémond and others on this subject, which is surrounded with much interest to us all.

Scrubbers.

It is astonishing how few works adopt the scrubber—perhaps the most profitable vessel in our plant; it not only saves much labour and material expended on the purifiers, but produces a valuable commodity, which is an item of considerable importance to the revenue of every Company who employ it.

The success that has attended liquid purification in the past, and the chemical knowledge we are ever gaining, induces me to think that the nineteenth century, famous for great discoveries, will have another added to its credit—one that will by liquids deprive coal gas of its gaseous impurities, and that in such a manner as to enable us to recover the sulphur from the sulphur compounds. The ideal of a chemical works, "that there should be no waste products," should be ours. I know three Members of this Association who are studying and experimenting in this direction of our science, and obtaining results so encouraging and satisfactory that they believe the "right track" is becoming visible, although many difficulties still blockade it. Let us hope the reward—success—that invariably attends perseverance in a good cause, will soon be theirs.

Purification.

To purify coal gas economically and well, the purifying space should be much greater than that possessed by many works represented in the report. To thoroughly utilize the purifying material, and free the gas from all impurities, it must be slowly passed through three or more purifiers. Oxide of iron does not appear to be a favourite purifying agent with Scotch Gas Managers; only a very few use it. Lime is unquestionably the best purifying agent yet discovered. Its use is, unfortunately, attended with considerable expense, and the nuisance it creates when fouled and exposed to the atmosphere are all that can be brought against it. We are to have the pleasure, to-day, of examining Mr. Hislop's process for the revivification of foul lime, which has effected great saving in the cost of lime for purification at the Paisley Gas-Works, and is, therefore, well worthy your inspection. Mr. Young has quite recently joined Mr. Hislop in patenting various arrangements of revivifying foul gas lime. The knowledge acquired through the present process, combined with the well-known ability and ingenuity of the patentees, has produced improvements whereby the cost of labour will be reduced to little, if anything, over half the cost the present system entails, and which, as I have already stated, effects "great saving." This improved apparatus of Messrs. Hislop and Young consist of a rotating cylinder of iron, lined with fire-bricks. The furnace for effecting the calcination of the lime is placed at one end, and the liberated gaseous impurities are drawn off at the other into a flue leading to the chimney stalk. The cylinder is slightly inclined to the furnace end, which causes the foul lime, which is charged at the higher end, to travel slowly the length of the cylinder. The rotary motion has a further advantage of turning the lime, and continuously exposing fresh surfaces to the action of the heated products of combustion from the furnace, which very much facilitates the liberation of the gaseous impurities. This will, in my opinion, almost dispense with manual labour, and secure great certainty of action. Any process that will revivify our waste lime at a small cost will be an immense saving to Gas Companies, until that time when liquids will supersede lime for gas purification.

You will be pleased to see from the programme that Mr. D. M. Nelson is to favour us with a paper on "Steel's Improved Apparatus for Purifying and Condensing Gas." I am not acquainted with this patented process, but I know, when Mr. Nelson undertook to bring it before you, that it will possess good points, and be the means of provoking an instructive discussion.

Pressure on Mains.

The day and night pressures suggest the great saving effected by governors. There is, I believe, no instrument connected with our industry for which more patents have been granted than the governor. I have found, from experience, Peebles's Patent Safety Governor to be a most reliable regulator of the pressure, and to possess, in its ingenious construction, the minimum of risks in regard to accidents. Foulis's Patent Governor, which is exhibited here to-day by the sole manufacturers, Messrs. W. and B. Cowan, is now in successful operation, both as a station and district governor, and found to be a most efficient instrument in either position. It possesses, like the governor already mentioned, advantages over its many predecessors with unprotected holders, in not being liable to pulsate, and in being proof against escapes of gas, that prove so disastrous to many works. A few months ago, Mr. Foulis invented a lamplighter and extinguisher, which was found, by experiments made in Glasgow on lamps 300 feet apart, to act not only as an efficient lamplighter and extinguisher, but also to perform the important duty of a street-lamp regulator. In this invention Foulis's patent governor plays the leading part. Mr. Scott will have the honour—through Mr. Foulis's kindness—of showing you the clever invention at work. For further information regarding it, I would refer you to the JOURNAL OF GAS LIGHTING, where a description of it will shortly appear. This mechanical lamplighter, &c., overcomes a great difficulty in being competent to light, extinguish, and regulate the consumption of gas in many street-lamps from a central position. I understand Mr. Foulis is not sanguine of great profits being made through its adoption. It settles the question, however, Can it be done? But I fear until the mechanical lamplighters, &c., can clean the lamp globes, and so dispense with the present lamplighters altogether, that their advantage will be trifling. Allow me, while on this subject, to remark that I believe the streets of London will be lighted by the electric light before electricity will light and extinguish gas street-lamps economically. Mr. Foulis lately added another to his numerous list of inventions—a street-lamp governor. The beauty of this instrument is that the pressure, or rate per hour, can be regulated by adjusting a ball, screwed on a small lever, without taking the governor to pieces.

Leakage, or Gas Unaccounted for.

I find, from the returns made under this head, that the leakage was as low in one works as 6 per cent., and as high in another as 28 per cent. There are many points in our system to which this loss can be traced. I would recommend all who have not a thermometer fixed in the inlet of the station-meter to get one, and should your condensing power be deficient, you will find a considerable proportion of the unaccounted-for gas due to its being registered at a higher temperature than what it was afterwards sold at. Main-pipe joints, connections, and old service-pipes contribute much to this loss, but certainly not more than old wet and dry meters. I find the ordinary wet meter, when watered four times a year, more profitable than the majority of dry ones. Mr. Dalziel, of Kilmarnock, is to honour us with a paper on "Non-Tilting Meters." This subject has long been a study of Mr. Dalziel's, and is one of great importance to all interested in the reduction of unaccounted-for gas.

Illuminating Power.

The illuminating power of the gas manufactured north of the Tweed varies from 24 to 33 standard candles. I am not in favour of reducing our standard to 20 candles. We must keep pace with the spirit of the age, and continue improving our artificial light, which the customs and amusements of society have rendered indispensable. The standard in England is year after year improving; and whenever the London Companies get over the sulphur difficulty, the public cry will doubtless be for higher illuminating power, and the Companies will, in all likelihood, comply with the demand, as they have ever done in the past. We cannot consider our process of gas manufacture complete until we can diffuse permanently through the gas all the naphtha vapours that are produced during the carbonization of the coal.

Mr. Young's lecture on "Carburetting Gas" will doubtless enlighten us all on a process that may soon be required either to raise or maintain our high standard of illuminating power.

Before closing my remarks, I wish to draw your attention to the benefits secured by receiving deposits from all consumers—say, equal to four months winter consumption. A satisfactory feeling can never exist between consumers and gas companies or corporations while the latter charge deposits from one section of the community, and allow the other—considered respectable—to go without them. I consider it unfair to continue the present system. It is wrong to make respect of persons, without there is sufficient cause. The test of a man's respectability or honesty, in the system generally adopted, is the number of apartments in the house he occupies. We all know that this is a most unsatisfactory test; for our experience teaches us that honest men live in the humble, as well as the higher, walks of life. From the ranks of consumers—considered respectable—without deposits, the bulk of bad debts accumulate; therefore, the consumers with deposits are discontented, and justly so, because they have to pay a proportion of these bad debts in being charged more for gas than they ought to be if all were placed on the same footing as regards deposits. Four, or even five, per cent. should be allowed on all deposits lodged for upwards of a year, and the interest paid, say, every three years after the deposit was lodged. By receiving deposits from all consumers they become shareholders in the undertaking, the bad debts are reduced to a mere trifle, and the time and trouble collectors have in hunting up defaulting consumers are greatly reduced. As an instance of how bad debts are got rid of, I may say that a corporation adopted the system of charging deposits from all consumers a few years ago, and they, for the nine months ending February, 1878, have now less than 2s. per £100 of bad debts.

Seeing we have a long and interesting programme to discuss, I will not detain you longer than to thank you for the patient hearing given me, and ask you to freely express your opinions on the subjects brought before the meeting for discussion.

On the motion of Mr. BLACK (Alexandria) a hearty vote of thanks was accorded to the President for his interesting Address.

Mr. H. AITKEN (Darroch) read the following paper:—

ON THE INFLUENCES OF AQUEOUS AND OTHER VAPOURS ON ILLUMINATING GAS.

Feeling a want of information upon certain points that arose in the working of what is known as the Aiken and Young process of gas-making, and being unable to obtain it, I have had during the last few years the following series of experiments made to determine the influences of the following substances in 25 to 27-candle gas—viz., benzole, atmospheric air, and aqueous vapours.

1. To determine the influence of benzole in the gas, I passed the gas over benzole of commerce contained in a tube, and the following are the results:—

—	Gas before coming in contact with the Benzole.	Gas after having passed over Benzole.	Gain.	Grains of Benzole by Weight to the Cub. Foot of Gas.	Grains of Benzole per Candle of Increase.
First Trial.					
Benzole of commerce .	25 candles.	29·6 candles.	4·6 candles.	13·85	3
Second Trial.					
Benzole of commerce .	27 ,,	31·62 ,,	4·62 ,,	13·87	3

Thus 2 gallons of benzole increase the illuminating power of 10,000 cubic feet of gas 4 candles.

—	Gas before coming in contact with the Naphthas.	Gas after having passed over Naphthas.	Gain.	Grains of Naphtha per Candle of Increase.
Third Trial.				
Light naphthas . . .	28·1 candles.	29·76 candles.	1·66 candle.	2·4

Thus 1·6 gallons of naphtha increases the illuminating power of 10,000 cubic feet of gas 4 candles.

In this last experiment the gas was passed over the crude naphthas, also enclosed in a tube. In all the trials the gas was passed over the benzole or naphthas immediately before going to the burner.

In making these experiments, a small amount of white matter was precipitated into the benzole that remained, but the quantity was too small to determine its character.

No doubt the influence of benzole or naphthas on gas of, say, 15 candles would be more marked; but not having this gas at command, no experiment could be made.

The great increase in the illuminating power got by using crude naphthas, compared with that got from the benzole of commerce, proves that the gas not only absorbs the benzoles from the naphthas, but also a considerable quantity of the heavier hydrocarbons, and that these have a greater illuminating power than pure benzole.

The practical lesson to be drawn from these experiments is that the tars,

as presently condensed, contain not only benzole, which, when properly condensed, should pass away with the gas, but also other hydrocarbons, even more valuable as illuminants, and also that when cold these heavier hydrocarbons can be taken up from the gas. This accounts, to some extent, for the high results got in working the Aitken and Young process. The general idea was that the *only* illuminants taken by the process from the tars were the benzoles.

2. To determine the influence of atmospheric air, I made experiments with the following results:—

Gas before being charged with Air, 27·82 Candles.

		Loss.	Loss per Cent.
Gas with ½ per cent. air added,	27·15 candles	·67 . .	2·41
„ 1 „ „	26·59 „	1·23 . .	4·42
„ 5 „ „	23·73 „	4·09 . .	14·70
„ 10 „ „	20·80 „	7·02 . .	25·23

As the quantity of air added diminishes the gas burned (the gas and air were mixed before passing through the meter), it is necessary to correct this table, so as to show the loss resulting from the quantity of gas, and not the mixtures actually consumed. The following table shows this:—

			Loss.	Loss per Ct.
With ½ per cent. air	27·15 candles + 1/190	·14 = 27·29 candles	·53	1·90
„ 1 „	26·59 „ + 1/99	·27 = 26·86 „	·96	3·45
„ 5 „	23·73 „ + 1/19	1·25 = 24·98 „	2·84	10·21
„ 10 „	20·80 „ + 1/9	2·31 = 23·11 „	4·71	16·93

Properties of Saturated Mixtures of Air and Aqueous Vapour under a Constant Pressure of One Atmosphere, or 14·7 lbs. per Square Inch, at Temperatures of from 32° to 219° Fahr.

Final Temperature of the Saturated Mixture or Dew-point.	Total Pressure per Square Inch.		Weight of 100 Cubic Feet.			Quantity of Heat in 100 Cubic Feet, reckoned from 32° Fahr. (Water at 32° for Vapour.)			Quantity of Heat in One Pound of Vapour, reckoned from Water at 32° Fahr.	Quantity of Dry Air required for One Pound of Vapour in Saturated Mixture.		Required Initial Temperature of the Dry Air to Evaporate One Pound of Moisture in Saturated Mixture.
	Vapour.	Air.	Vapour.	Air.	Saturated Mixture.	Vapour.	Air.	Saturated Mixture.		Weight.	Volume at 62° F.	
Fahr.	lbs.	lbs.	lbs.	lbs.	lbs.	Units.	Units.	Units.	Units.	lbs.	Cubic Feet.	Fahr.
32 degs.	·089	14·611	·031	8·023	8·054	33·8	0·0	33·8	1091·2	258·8	3401	49·7
35 „	·100	14·600	·034	7·970	8·004	37·1	5·7	42·8	1092·1	234·4	3080	54·6
40 „	·122	14·578	·041	7·879	7·920	44·8	15·0	59·8	1093·6	192·2	2526	63·8
45 „	·147	14·553	·049	7·785	7·834	53·6	24·1	77·7	1095·1	158·9	2088	74·0
50 „	·178	14·522	·059	7·693	7·752	64·7	32·9	97·6	1096·6	130·4	1714	85·4
55 „	·214	14·486	·070	7·598	7·668	76·8	41·5	118·3	1098·2	108·5	1426	97·6
60 „	·254	14·446	·082	7·507	7·589	90·1	50·0	140·1	1099·7	91·6	1203	110·5
65 „	·304	14·396	·097	7·410	7·507	106·8	58·1	164·9	1101·2	76·4	1004	125·6
70 „	·360	14·340	·114	7·311	7·425	125·6	64·1	189·7	1102·8	66·0	868	140
75 „	·427	14·273	·134	7·208	7·342	147·9	73·7	221·6	1104·3	55·0	723	160
80 „	·503	14·197	·156	7·106	7·262	172·5	81·1	253·6	1105·8	45·6	599	182
85 „	·592	14·108	·182	6·996	7·178	201·6	88·1	289·7	1107·3	38·4	505	206
90 „	·693	14·007	·212	6·896	7·108	235·1	95·1	330·2	1108·9	32·5	427	233
95 „	·809	13·891	·245	6·764	7·009	272·1	101·3	373·4	1110·4	27·6	363	264
100 „	·942	13·758	·283	6·641	6·924	314·7	107·3	422·0	1111·9	23·5	308	299
105 „	1·095	13·605	·325	6·505	6·830	361·8	112·9	474·7	1113·4	20·0	263	344
110 „	1·267	13·433	·373	6·368	6·741	415·8	118·1	533·9	1115·0	17·1	224	385
115 „	1·462	13·238	·426	6·224	6·650	476·4	122·7	599·1	1116·5	14·6	192	436
120 „	1·685	13·015	·488	6·063	6·551	545·6	126·8	672·4	1118·0	12·4	163	499
125 „	1·932	12·768	·554	5·900	6·454	620·1	130·4	750·5	1119·5	10·7	140	567
130 „	2·215	12·485	·630	5·717	6·347	706·2	133·2	839·4	1121·1	9·1	118	667
135 „	2·542	12·158	·714	5·524	6·238	801·5	135·2	936·7	1122·6	7·74	102	745
140 „	2·879	11·821	·806	5·325	6·131	906·0	136·7	1042·7	1124·1	6·61	86·8	856
145 „	3·273	11·427	·909	5·106	6·015	1023·4	137·2	1160·6	1125·6	5·62	73·8	986
150 „	3·708	10·992	1·022	4·869	5·891	1151·8	136·6	1288·4	1127·2	4·77	62·6	1,145
155 „	4·193	10·507	1·145	4·619	5·764	1292·3	135·1	1427·4	1128·7	4·03	53·0	1,332
160 „	4·731	9·969	1·333	4·346	5·679	1506·5	132·2	1638·7	1130·2	3·26	42·8	1,618
165 „	5·327	9·373	1·432	4·055	5·487	1620·6	128·2	1748·8	1131·7	2·83	37·1	1,847
170 „	5·985	8·715	1·602	3·739	5·341	1815·0	122·6	1937·6	1133·3	2·33	30·7	2,212
175 „	6·708	7·992	1·774	3·402	5·176	2013·1	115·6	2128·7	1134·8	1·92	25·2	2,665
180 „	7·511	7·189	1·970	3·036	5·006	2239·0	106·8	2345·8	1136·3	1·54	20·3	3,280
185 „	8·375	6·325	2·181	2·651	4·832	2481·7	96·1	2578·1	1137·8	1·22	16·0	4,124
190 „	9·335	5·365	2·411	2·231	4·642	2747·0	83·8	2830·8	1139·4	·93	12·2	5,368
195 „	10·385	4·315	2·662	1·781	4·443	3037·0	69·0	3106·0	1140·9	·67	8·8	7,370
200 „	11·526	3·174	2·933	1·300	4·233	3350·6	51·9	3402·5	1142·4	·44	5·8	12,840
205 „	12·770	1·930	3·225	0·785	4·010	3689·5	32·3	3721·8	1143·9	·24	3·2	19,985
210 „	14·126	·574	3·543	0·232	3·775	4058·2	9·8	4068·0	1145·5	·065	·86	73,940
212 „	14·700	·000	3·683	0·000	3·683	4221·1	0·0	4221·1	1146·1	—	—	—

These results show that the influence of a mixture of air in 27-candle gas is not so detrimental as one would have supposed. It is also to be noted that the deterioration does not proceed in equal ratio with the quantity of air added, a result I certainly was not prepared for.

3. To determine the influence of aqueous vapours the following experiments were made. The gas was dried by being passed through a tube containing fragments of anhydrous chloride of calcium.

The gas before being dried was 27·24 candles, and when dried 27·46, an increase of ·22 candle. The gas was measured before being dried, and no doubt was completely saturated with aqueous vapour, both from the holder, the meter, and the governor.

The temperature of the water in these was 59° Fahr., which gives a tension of aqueous vapour (when saturated) of 13 millimètres out of a total of 760 millimètres of the barometer. This is 1·71 per cent. by weight, or almost 2·8 per cent. by volume. By drying, therefore, there is a loss of 2·8 per cent. in the volume of the gas, and a gain of ·8 per cent. in the illuminating power. This is not a gain worth fighting for *per se*, but the advantage of drying gas will be further alluded to. No doubt the advantage of drying poor gases will be very much more marked than rich, but I have had no opportunity of testing them. Of course you are aware that the power of gas to absorb and retain aqueous vapours increases in proportion to the temperature, and I incorporate here, in illustration of this, a table from "Dr. Clark's Manual of Rules, Tables and Data for Mechanical Engineers," showing the quantities of aqueous vapours contained in air at different temperatures.

The power of the gas to retain naphthas is also increased by increased temperature. It would be perfectly useless to dry gas, and then pass it through a wet meter, particularly if, after that was done, the gas was subjected to a temperature below 32°. Besides the gas would soon take up all the water in the meter.

The advantage of drying gas may not be one of very great moment in a climate like ours, and with such gas as we have; but, in countries where the temperature is very low, it is a matter of great consequence, as it enables the gas to retain larger quantities of benzole, naphthaline, and other hydrocarbons. To determine this point, I had a long series of experiments made, and found that undried gas, at a temperature of 50°, absorbed only a quarter of the quantity of benzole that dried gas did, and that when these gases were reduced to a temperature of 32°, the undried gas lost or dropped down nearly 30 per cent. of the naphthas it had absorbed, whereas the dried gas dropped less than 12 per cent.

The naphthas used in these experiments were extracted from coal gas by means of heavy oil, and then distilled for separation, and their specific gravity ranged from ·808 to ·830. After the gas had passed over these naphthas, there was a marked increase in the specific gravity. The ·808 had risen to ·812, and the colour of the naphthas was considerably darker. on the temperature of 25 to 27 candle gas being reduced to 32° it drops equal to 7000 grains of naphthas or benzole to 10,000 cubic feet (along with the quantity of water due to the change in temperature), and according to the foregoing experiments this means a loss of illuminating power of about a quarter of a candle.

These experiments were made by passing the gas through two jars, 6 inches by 7 inches, the gas being let in at the top, and out, through a tube, from the bottom.

The jars were kept immersed in a freezing compound, and the gas brought off as nearly as possible at 32°. In this way there was a continuous current through the jars. This brings me to another important point—viz., the influence of current, or the want of it, on the dropping down point of naphthas. The experiments undertaken with the view of determining this are not yet completed, but they are sufficiently advanced to enable me to say that 25 to 27 candle gas, at a temperature of, say, 40° to 50°, will in a current not only not drop down its naphthas, but will, on the contrary, lick up a very considerable quantity, and hold it so long as motion continues.

One curious feature in the experiments made to determine this is the unexpected compounds that drop from the gas while in a state of rest or partial rest. At one time they are black substances like clotted blood, at another they are white, and sometimes they are partly both. The black substance sinks in water, while the white does not; but their chemical composition I have not yet determined, not having got sufficient quantity to operate on.

I think these experiments are sufficiently advanced to enable me to say that the deposition of the naphthas on the water in the gasholders may be almost, if not entirely, prevented, by placing on the top of the outlet-pipe from the gasholder a dome, or an arrangement like a flat umbrella, so that the gases, before leaving the gasholder, may go down to within a few inches of the water, and so lick up any naphthas that may have been deposited on its surface, and that the pipes to which the drip-boxes in the streets are connected should be made flat in the bottom, and that the pipe connecting the drip-boxes with them shall be placed at the very bottom, so as to allow the water to be pumped off first. In this way I expect that in most situations any naphthas that drop from the gas (so long as the temperature does not come below, say, 35°) would be carried off by the gas so soon as it got into motion; the quality of the gas remaining uniform.

The experiments I have made on the influence of steam put into gas, and thereafter condensing it, show results, so far as I have gone, so conflicting that I will require to repeat them on a larger scale and with apparatus more complete.

My time being much occupied otherwise, I had to get others to perform most of the experiments—viz., Dr. Wallace, of Glasgow, and Mr. M'Alley, of Falkirk. Indeed, these gentlemen performed nearly the whole of the experiments, and they therefore carry much more weight than if they had been made by myself in those short intervals we call leisure.

Mr. Davidson (Dawsholm): I should like to ask Mr. Aitken whether he has made experiments as to the permanency of the increase in illuminating power through the use of benzole, and whether, if the gas has to travel a considerable distance, there is no difference in the increase at its utmost limit.

Mr. Hislop: I have listened with great interest to this paper to-day. I can corroborate Mr. Aitken's remarks on the matter of the absorption by gas of those hydrocarbons deposited on the surface of the water in the tanks and drips in the streets. A number of years ago a chemical manufacturer called upon me, and represented that he had discovered a very large quantity of benzole floating on the water inside the gasholders, and

he brought a special pump to prove the existence of the oil, and really it was found to the depth of five-eighths of an inch in the gasholder. After consideration of the subject, I conceived that there would be no gain in pumping up these oils by the means he suggested, as I guessed that they would be utterly useless. In the summer, however, I found that the whole of the benzole had disappeared. There was not a single vestige of it to be found on the surface of the water in the gasholder. It, therefore, seems that the gas drops these oils in the winter months, and that in the summer it takes them up again, when the temperature is higher, and the gas in that condition to which Mr. Aitken has referred, and the illuminating power of the gas is thereby increased. The same thing might be said about the drips, if there was any convenient means of lifting the oils out. But I see some difficulty in putting the diaphragm into the drips, so as to compel the gas to go down. There might be a danger of the oils flowing up, and putting some sections of the town into sudden darkness. I can, in the main, however, corroborate the views of Mr. Aitken as to the quality of the gas after taking up these hydrocarbons, as that is quite within my experience, and I believe, in the case of a town where the drips in the mains are not large, the same thing will take place, and the illuminating power of the gas in summer will be increased by the deposit in winter. It is a fact within my experience that we can give higher illuminating power of gas in summer than in winter, and I believe it is altogether attributable to this fact, that the gas takes up in summer a large portion of the hydrocarbons which have been deposited in cold weather. Upon the whole, I think that Mr. Aitken has contributed some very important matter to the science of gas lighting, in showing the effect of dry gas, and its power of retaining those hydrocarbons. I propose a hearty vote of thanks to Mr. Aitken for his paper.

Mr. DALZIEL: I can corroborate Mr. Hislop in his remarks about the oil being deposited on the surface of the water in the holders. During the winter a quantity of greasy matter gathers inside the holders, and I have further noticed that in summer weather, by putting in low-class coals, equal to 23 or 24 candles, the illuminating power was equal to winter. The only reason I could give for this phenomenon, which I have noticed for years, is, that the hydrocarbons stored and collected during winter were absorbed by the gas during summer, and made use of then. I think if naphthas are deposited at one time of the year they are taken up at another.

The PRESIDENT: I suppose the reason why no other Member desires to speak is, that we are all agreed upon what Mr. Aitken has said, and think that he is on the right track. I will now ask Mr. Aitken to reply.

Mr. AITKEN: In answer to the question of Mr. Davidson as to the permanency of the gas after the absorption of the benzole, I should explain that the experiments were not made with the view of ascertaining that. They were made to ascertain correctly how much benzole it takes to increase 10,000 feet of gas a candle, or four candles, or whatever it might be; or, to put it otherwise, to see how many gallons of benzole it would require to increase the illuminating power of ordinary 25-candle gas four or five candles, and to see what was the effect of a given quantity of benzole with a given quantity of gas. Perhaps people hold different opinions upon the power which the gas might have to carry off the benzoles. As I apprehend, it depends upon the temperature. It may be, however, that if the gas comes out of the holder cold, and, after passing into the streets, gets heated, it would certainly have the power of permanently carrying benzole naphthas along with it. If, on the contrary, when the gas reached the pipes the temperature was reduced, I have no doubt the gas would drop the benzole. It is entirely a question of temperature. What Mr. Hislop said, about gas in summer being richer from the hydrocarbons picked out of the gasholder, is quite true. By the deposition of these hydrocarbons in the winter an advantage is obtained in summer, but it is not in the summer that you want this advantage most. Winter is the worst time to keep up a good quality of gas, and by dropping the benzole in winter you drop it at the very time when it is most required. Then, as pointed out by Mr. Dalziel, not only is the benzole on the top of the water, but benzole covers every pipe, and, of course, in summer the gas has not only to take the benzole off the top of the water, but it has to wash the benzole off all the surface pipes, or, at all events, every pipe where a deposition has been made when the temperature was low. I do not suppose you will get this deposition to a great extent in houses, unless the gas is made from shale at a low temperature, when I know the naphthas, or benzole, or whatever other term you may apply, settle down at a higher temperature than those made by ordinary coal gas.

The vote of thanks proposed by Mr. Hislop to Mr. Aitken for his able paper was cordially given.

(To be continued.)

THE USE OF WATER AS A MOTIVE POWER.

By Mr. JOSEPH PARRY, C.E.

[A Paper read before the Liverpool Polytechnic Society, Dec. 17, 1877.]

Many centuries before Hero invented the Æolipile, and before the Saracens constructed a wind-mill, water power was employed to drive corn mills on the banks of the Nile and Euphrates, and to irrigate the rice fields of China. History does not tell us, and even tradition is silent, as to the time when water was first used as a motive power; but, although a knowledge of the means of deriving useful work from an element so widely diffused, has been so long before the world, and much ingenuity was displayed in remote ages in connection with its application, it was not until a few years ago that any great improvement was effected, and substantial progress was made.

The wave of mechanical invention that passed over this country during the latter half of the last century did not contribute much to the advancement of hydraulic machinery. The discoveries of Watt, and the cheapness of coal, attracted so much attention to the use of steam, that every other class of machinery was almost entirely neglected.

Joseph Bramah, the inventor of the hydraulic press, appears to have been the first to suggest the application of water pressure "to convey motion and power to the cranes on dock quays and elsewhere, and for raising and lowering goods in and out of warehouses."* But it is to Sir Wm. G. Armstrong that the modern development of water pressure machines is almost entirely due; and he has recently, in an interesting paper read before the Institution of Civil Engineers,† related how his attention was first directed to the subject. Sir Wm. G. Armstrong, who is now a Vice-President of the Institution of Civil Engineers, and a Past President of the Institute of Mechanical Engineers, was formerly a solicitor. When travelling through the valleys of the Craven district of Yorkshire, he was led to observe the numerous rills descending the steep slopes of the surrounding hills, and expending their energy in the production of foam. He found it was seldom that any attempt was made to utilize the power thus bountifully provided, and that where such attempts were made, the amount of work realized was very small in proportion to the extent of fall available. He was, therefore, led to consider how such falls might be made more productive, and he succeeded in devising a machine consisting of a "wheel with a flat rim, containing four equidistant pistons folding into circular apertures, and intersecting longitudinally a curved tube open at the lower end, and communicating at the upper end with the supply-pipe. The pistons open out as they enter the tube, and fold upon leaving it; and each piston takes the pressure of the column before the preceding one loses it. The opening and closing of the pistons, in the order required, is effected by external cams and slides, giving motion to the pistons through the axles on which they turn."*

A working model of this machine was made and tried in Newcastle, and gave an efficiency of 90 per cent. of the theoretic power of the head employed. Having applied his mind to the subject, his views soon extended, and assumed a practical form in the erection of a hydraulic crane on the Newcastle Quay. Subsequently two cranes, which are still in operation, were erected at the Albert Dock, Liverpool, and worked by pressure from the Corporation mains. About the same time Sir Wm. Armstrong abandoned the legal profession, and devoted himself entirely to engineering.

The purposes to which water is now applied as a motive power, and for the transmission of power, are so numerous, that it would be impossible to deal satisfactorily with the whole of the subject within the limits to which I must confine myself to-night. I propose, therefore, to restrict my remarks almost exclusively to that branch of the subject which relates to the direct use of water pressure from the water-works mains in Liverpool.

No paper under the title which I have chosen would be complete without some reference to the vast energy that is to be found in the river to which Liverpool owes so much of its importance. I shall merely remark, in passing, that the question of utilizing the rise and fall of the tide, or the rotation of the earth, for driving machinery, is so large and interesting that it deserves to be separately treated, and on some future occasion I may perhaps return to it.

It is no part of my present object or intention to discuss the comparative merits and economy of different prime movers, or to attempt to assign to water power its relative position among the many claimants for adoption. There are engineers who advocate and urge the universal application of a particular class of machinery, or a particular kind of power, in the success of which they are generally more or less interested. They are like certain doubtful professors of the art of healing who have one remedy for the cure of every disease. The skilful physician, on the contrary, studies the symptoms of every case in which he is called upon to prescribe, and adapts his treatment to the nature of the malady and the physical state of the patient. In the same way it is the duty of the engineer to consider the special circumstances and conditions of every case upon which he is consulted, and, having regard to all those circumstances and conditions, to select the means which are best adapted to accomplish the work that has to be performed. What is really important to him is to have trustworthy data upon which to base his calculations and conclusions, and to guide him in the application of general principles. The results which will be laid before you, of experience extending over a somewhat wide range of practice, may be of some service in the way thus indicated. At the same time I shall endeavour to give such general information on the subject as may be of interest to those who do not possess any special knowledge of water pressure machinery.

Present Use of Water for Power from the Liverpool Corporation Mains.

In considering the use of water pressure from the Corporation mains as a motive power, and the extent to which it is possible to make further applications of the same kind, it may be desirable at the outset to inquire what are the resources which we have at command.

The existing works of the Corporation are estimated by the Borough and Water Engineer to be capable of supplying about 18¼ million gallons, or 81,632 tons, of water per diem. This volume can be delivered from the mains at pressures ranging from 20 lbs. per square inch to 80 lbs. per square inch. At the average pressure available throughout the district of supply each 1000 gallons of water distributed represents, if fully utilized, an ability to produce mechanical work of about 410 foot-tons. In the lower parts of the town, where most of the business premises are situated, the average pressure is much higher than the average over the whole district of supply, and each 1000 gallons of water represents about 560 foot-tons. If this were converted into work through machinery giving an efficiency of only 75 per cent., the value in foot-tons of each 1000 gallons would be about 420.

The price at which water is sold in Liverpool for trade purposes is 9d. per 1000 gallons.

The cost of water per horse power per hour within a line drawn at a distance of one mile from, and parallel to, the river varies from 11d. to 1s. 3d.

I now proceed to inquire, What is the actual consumption of water in Liverpool at the present time for purposes of power? The following statement gives the number of gallons distributed during the last twelve months:—

	Gallons.
For hydraulic hoists and cranes	44,542,290
For organ blowing	3,624,000
Miscellaneous	657,000
Total	48,823,290

Lifts and Hoists.

These may be divided into three classes, according to the character of the apparatus through which the power is communicated.

The direct-acting lift is the simplest form employed, and gives the highest co-efficient of useful effect. It consists of a cylinder and ram, to the top of which is attached a platform, cage, or room, supported on iron brackets. The height of the lift is thus determined by the length of the stroke of the ram; and the area of the ram, multiplied by the available head of water in the cylinder, is the measure of the power of the lift. The cylinder is usually fixed in a well, or bore-hole, sunk for the purpose; and where the height of the lift is considerable, the cost of sinking the well, or hole, and the difficulty of access in the event of repairs being required to the cylinder—which, however, is of very rare occurrence—are objections to this otherwise desirable and popular arrangement. The supply of water is admitted to the cylinder from the water-works main, and the platform or room ascends until stopped by the closing of the supply-valve. The same operation opens the exhaust, and the platform or room descends by its own weight.

Lifts of this description are much in favour for the conveyance of passengers, because of the smoothness with which they run, and the absolute impossibility of any accident taking place. The rooms in which the passengers are conveyed are often luxuriously furnished.

Hoists with multiplying gear are generally adopted where the travel exceeds 20 feet. They consist of—(1) A cylinder and ram similar to those described above, but instead of the platform or cage being attached to the top of the ram, multiplying sheaves are used in the inverted order of pulleys and blocks. A chain is usually carried from a pulley fixed in a bracket cast on the cylinder side over sheaves working in a cross-head

* Letter to Mr. Thomas Mallet, Nov. 10, 1802. *Vide* Minutes of Proceedings of the Institution of Civil Engineers, Vol. xlix., p. 30.

† *Vide* Proceedings of the Institution of Civil Engineers, Vol. l., p. 64.

* *Vide* Proceedings of the Institution of Civil Engineers, Vol. l., p. 64.

layed to the top of the ram, and up to a sheave at the top of the shaft, above the highest point of the lift. (2.) Another arrangement, of which there are only a few examples in Liverpool, consists of a cylinder and piston working by rack-and-pinion motion. The hoist is actuated by a rope or chain winding on a flanged wheel fixed on the end of the pinion shaft, and communicating with the cage over sheaves.

There are in Liverpool several instances of hoists worked by rotary engines, and engines of this type are becoming more in favour. Various kinds of engines with oscillating cylinders are in use, and recently two of Brotherhood's three-cylinder engines have been fixed. In all these cases the engine takes the place of the cylinder and ram, and communicates motion by a rope or chain. The pattern recommended by Sir William Armstrong, where there is sufficient space, is a two-cylinder oscillating engine, fitted with combined rams and pistons, working on over-end cranks placed at right angles to each other.

The non-elasticity of water, which is such a valuable property as a means of accumulating and transmitting energy becomes a source of danger when, a column having been set in motion, it is suddenly arrested by the closing of a valve or the termination of a stroke. To obviate this danger, and prevent injury by shocks and strains to the machinery and mains, it is necessary to provide capacious air vessels, or relief valves, in connection with all water pressure machinery. The neglect of this precaution has frequently been the cause of serious damage. The relief valves introduced by Sir William Armstrong are small clacks opening against the pressure in the supply-pipes, and yielding readily whenever any undue increase in the pressure takes place.

Several forms of inlet and exhaust valves are in use. They are chiefly of two kinds—slide valves, and equilibrium mitre valves. Owing to the difficulty of moving slide valves of a large area, it is usual to make the ports small, in proportion to the area of the pipes to which they are attached, thus increasing the velocity of the water at that point, and often causing considerable loss through friction. It is essential to have the valves constructed so as to close gradually, and avoid producing a concussion in the supply-pipes.

The equilibrium mitre valves are the most satisfactory that have yet been introduced, from the ease with which they can be moved, and the area of opening they afford.

The valves of hoists are actuated through levers by a rod, chain, or rope, passing up the shaft at one side of the platform or cage. A slight pull suffices to stop the hoist at any point during ascent or descent. The floors of the hoists are usually fitted with tappets arranged to strike upon projecting bars or pieces on the valve pull. This contrivance renders it impossible for any damage to be done by neglect in shutting off the water at the proper moment.

As a provision against the possible breaking of the lifting chain or rope, hoists of classes 2 and 3 are generally furnished with a safety appliance to prevent the room or platform falling more than two or three inches under any circumstances. Strong safety ratchets are carried up the sides of the shaft from a firm bearing at the bottom to the highest point of the lift, or the ordinary guide timbers are made to answer the same purpose. The safety appliances consist of heavy iron pawls, cams, or eccentric ratchet wheels, combined with powerful steel springs. In ordinary work the springs are held in tension, but in the event of the rope or chain breaking, the springs, relieved of their weight, would immediately force the pawls, cams, or eccentrics into contact with the safety ratchets or guide timbers, and remain locked there until the load was again raised.

Compensating counter-balances are of two kinds—

1. Where the weight of the counterpoise is equal to that of the cage or platform and ram, and is connected by a rope carried over a pulley at the top of the shaft; the space passed through being equal for both.

2. Where the weight of the counterpoise is double that of the cage or platform, and acts on a drum keyed on the same axis as another drum of twice the radius, so that the space travelled by the counterpoise is half the height of the lift.

The speed at which hoists are worked varies from 50 to 150 feet per minute.

The following statement gives, in a tabular form, information with respect to a few cases which have been selected as fair average examples of machines of various types and by various makers:—

Description of Lift.	Diameter of Ram or Piston.	Length of Stroke.	Height of Lift.	Maximum useful Load in actual Practice	Pressure in Main in Pounds per Sq. Inch.	Cost per Lift for Water only, in Pence.	Cost per Ton raised One Foot, in Pence.	Total Cost per Annum for Water.
	In.	Ft. In.	Ft. In.	Cwts.				£ s. d.
A. Direct-acting ram lift	18¾	21 2	21 2	30	50	2·18	·068	12 3 9
B. Direct-acting ram lift	13	15 3	15 3	20	54	·78	·051	6 5 9
C. Direct-acting ram lift	8¾	50 10	50 10	15	57	1·18	·030	105 7 1*
D. Multiplying piston	24	7 0	58 0	15	52	1·23	·028	120 8 5†
E. Ditto ram	23½	4 3	40 0	6	67	·71	·059	69 19 6
F. Ditto piston	19	10 0	72 0	7	68	1·09	·043	60 0 9
G. Ditto ram	21	4 3	57 6	7	68	·56	·028	10 14 6
H. Ditto ram	23½	6 6	76 0	10	56	1·09	·028	16 6 3‡
J. Ditto ram	23½	6 4	86 0	10	50	1·06	·059	63 9 0‖
K. Ditto ram	18½	7 3	57 6	7	74	·75	·037	22 10 9
L. Two-cylinder oscillating, E.	4	0 9	50 0	4	69	—	—	14 17 0
M. Rack-and-pinion piston	16¼	6 6	37 0	3	44	·54	·097	3 8 3
N. Rack-and-pinion piston	18¼	9 0	46 0	6	75	·93	·067	20 5 9
O. Rack-and-pinton piston	19¼	6 2½	51 0	10	71	·72	·026	— ‖

The load given in column 5 is the maximum load actually raised in the ordinary course of work. It has been ascertained by inquiry from the persons in charge of the machines, and must not be taken as representing their full power. The full power has, however, been obtained by experiment in three of the cases, and is given in the notes to the the table.

No counterbalance is provided for any of the direct-acting lifts, except the passenger lifts; therefore the weight of the platform and ram must be added to the load stated in the table in order to arrive at the total weight lifted by the water.

As to the cost of erecting this class of hydraulic machinery, the following particulars, having reference to work recently executed, may be of interest:—

The total cost of the hoist marked H, including the connection with the main, was £304. This hoist is in daily use in a Wine and Spirit Merchant's establishment, and the average cost per working day for water is 11·4d.

The hoist marked O cost £168, including the communication-pipes, but not including the cage. A 10 cwt. hoist, fixed within the last few weeks, cost, including communication-pipes, £376. The dimensions of this hoist are—Diameter of ram, 23½ inches; stroke, 7 feet 6 inches; lift, 69 feet; and the speed is 170 feet per minute.

The total number of lifts and hoists supplied from the Liverpool Corporation mains is 70.

Variation of Load.

One of the objections to water-pressure machinery is that water, not being, like steam, capable of expansion, the power expended does not vary in proportion to the load to be raised or work to be accomplished; therefore, waste takes place where the maximum capacity of a machine is not exerted. There are, however, several ways in which loss from this cause may be partially, if not entirely, prevented.

1. By employing two or more pressure cylinders, so arranged that they may be made to act separately or collectively upon the lifting chain.

2. By a combined piston and ram; the proportion between their respective areas determining the amount of variation. For the higher load the water is admitted below the piston, and the power due to the pressure on the full area of the cylinder obtained. For the lower load the water is admitted to both sides of the piston. The power exerted is then in proportion to the area of the ram.

3. By two concentric rams, working one within the other in the same cylinder, the external ram being secured by a pawl when not required.

Although the expenditure of water may be economized, wherever there is much variation of load, by the adoption of any of these expedients, it is not often they are resorted to, as the simplicity and ease of single-power machines are generally preferred to the economical advantages of the arrangements described. Nor is the loss from this cause so great as might be supposed when regarded as a per centage on the gross expenditure during any given period. No consumption takes place when no useful work is being done, and whatever loss there may be is, therefore, strictly limited to the intermittent operations of the machine.

Hydraulic Cranes.

Allusion has already been made to the hydraulic machinery at the Albert Docks. This affords the only instance in Liverpool of cranes worked by pressure from the public distributing mains. The difficulties experienced here and elsewhere in consequence of the variable draught from pipes used for general purposes of distribution led to the early abandonment of this mode of working in favour of an artificial head obtained from an accumulator—an apparatus devised by Sir Wm. Armstrong, and to be hereafter described. At the Albert Warehouses there are two cranes and two lifts; the former for raising goods from ships holds to the quay, and the latter for lifting goods from the quay to the several floors of the warehouses. The machinery for working the hydraulic cranes consists of two cylinders and pistons, one for lifting the load, and the other for slewing the jib. They are fixed horizontally in a chamber below the surface of the ground near the foot of the crane. The outer end of the piston of the cylinder for lifting the load carries moveable pulleys, around which the lifting chain passes from fixed pulleys attached to the inner extremity of the cylinder, to which the end of the chain is also secured. From the moveable pulleys the chain passes up the crane post and along the jib to the load to be raised. The slewing of the crane is accomplished by a rack connected with the piston, and gearing into an upright shaft acting upon the base of the crane. The motion of both lifting and swinging is controlled by levers attached to the inlet and outlet valves, and actuated by a handle above the ground level.

Considerable improvements have been effected in this class of machinery since the erection of the Albert Dock cranes. Rams have been substituted for the pistons, and the cost both of construction and maintenance has been greatly reduced. The application of water pressure to cranes has now become very general.

The cost of raising a load (which, in practice, averages 16 cwt.) from a ship's hold to the top of the Albert Warehouses, a height of 88½ feet, by the system described above, is, for water only, 2·1d. The cost of raising the load from a ship's hold to the quay (about 36 feet), including the slewing, is 0·6d., and from the quay to the top floor of the warehouse (52½ feet) 1·5d. The total annual cost of working this machinery, for water only, is £275.

Organ Blowing.

This is a purpose for which water power, with its steadiness and ease of control, is peculiarly well adapted, and for which it is in much request. There are, in the Liverpool district of supply, 14 organs blown by water pressure from the Corporation mains. Of these, four are in private houses, four are in chapels, and six in churches. The machine used for communicating the water power in these cases is, with only two exceptions, the ordinary Deacon water-meter, a patent of the late Water Engineer. This meter is the one that is chiefly used in Liverpool, especially in the larger sizes, to measure water distributed for trade purposes, and is very easily applied as a water motor. It has two cylinders, and the water is admitted through a slide-valve to each side of the pistons alternately. A rotary motion is obtained by slotted piston-rods working short crank-shafts. Where the Deacon engine is employed, the index motion attached to it registers accurately the volume of water passing through. With other forms of engines a meter has to be added to ensure a correct record of the consumption being obtained. The power is taken from the Deacon meter by connecting-rods communicating between the ends of the piston-rods and the levers of the organ bellows. The engine is made automatic by means of a rod connecting the bellows reservoir with the inlet valve. When the reservoir is full, the valve is closed, and as the contents are withdrawn the valve is opened.

The average annual cost of the water consumed in connection with the private organs is £1 4s. 9d. for each organ. The cost of blowing the church organs by water varies from £5 6s. 6d. to £29 13s. 3d. per organ per annum. The average cost is £15 18s. 11d. per organ per annum. As some of the organs included in the above summary are known to be much used for choir and private practice, the averages given do not afford a correct measure of what may be termed the ordinary useful consumption. I have, therefore, had special observations made in the following cases to ascertain the actual expenditure of water during one Sunday.

Case A is a church organ in the centre of the town, of 26 stops and five couplers. The cost of the water for one Sunday was 1s. 4d.

Case B is an organ of 25 stops and two couplers, in a Nonconformist chapel, where the available pressure is about the same as in case A. The cost of water for the Sunday was 2s.

Case C is an organ of 31 stops and five couplers, in a Roman Catholic chapel. The water consumed during one Sunday cost 6d.

Case D is an organ of 28 stops and seven couplers, in one of our parish churches, very favourably situated for pressure. The cost of the water for one Sunday's work was 2s. 9d.

Case E is a large organ in a well-known "High" church in the outskirts. The water consumption during one Sunday, at the same rate per 1000 gallons as in the preceding cases, cost 4s. 6d.

* Passenger lift. Ascent in 12 to 30 sec. † Maximum power of lift, 19½ cwt.
‡ Maximum power of lift, 18 cwt.
† Passenger hoist. Weight of room, one ton; weight of counterbalance, 23½ cwt.; time of ascent, 18 sec.; maximum number of passengers taken up at one lift, 15.
‖ Recently fixed. Maximum power ascertained by experiment to be 12·2 cwt.; time occupied in ascent, 2 min. 34 sec. With 11 cwt.: time, 1 min. 7 sec.; pressure in air vessel, 70 lbs.

Miscellaneous.

The miscellaneous purposes to which water power from the mains is applied in Liverpool are—to drive ventilating fans, for stone-crushing, and hair-dressing. The cost to a fashionable hair-dresser of driving his rotary hair-brushing apparatus is £1 19s. 9d. per annum. In this instance a Deacon meter is used, and a sum of £1 1s. per annum is charged as rent, and to cover the cost of inspection and ordinary repairs. The total cost per annum is therefore £3 0s. 9d.; and the average cost per working day is 2·3d.

The head required to work the Deacon meters, to overcome friction, is as follows:—1 in. meters (cylinders 3½ in. diameter and 5 in. stroke), 5 ft. 8 in.; 2 in. meters (cylinders 5½ in. diameter and 6 in. stroke), 5 ft.; 4 in. meters (cylinders 8 in. diameter and 11 in. stroke), 3 feet.

Other Water-Pressure Machinery.

The difficulties attending the working of cranes and similar machinery direct from the water-works mains, to which reference has already been made, and the expense of erecting elevated tanks from which to derive a steady head, led to the construction of the accumulator, an apparatus which has become the most distinctive feature of the system of water-pressure machinery with which the name of Sir Wm. Armstrong is associated, and which has contributed more than anything else to its rapid development and success.

The accumulator consists of a large vertical cast-iron cylinder, fitted with a loaded plunger working through a leather collar or gland. The weight case is suspended from a cross-head attached to the top of the plunger, and slides over the cylinder.

The cylinder is made of sufficient capacity to deliver the volume that would be required if all the machinery fed from it were in simultaneous action. The pressure in the cylinder is, of course, determined by the load upon the plunger. In practice it is generally about 700 lbs. per square inch, though a much higher pressure is frequently employed.

The accumulator is charged by a steam-engine, the power of which it accumulates at a constant pressure, thus giving a steady head, and enabling the continuous action of the steam-engine to be fully utilized in the intermittent action of the hydraulic machinery. When the supply from the engine exceeds the demands of the machinery connected with the accumulator, the plunger rises, and more water is stored in the cylinder. On the other hand, when the demand is in excess of the supply, the plunger descends until a balance is restored. The valve of the steam-pipe is controlled by levers from the plunger, so that the speed of the engine is regulated by the rise and fall in the cylinder.

From the accumulator the pressure may be transmitted to any required distance, diminished only by the friction against the sides of the channel conveying it. In the case of pipes the loss by friction is practically *nil*.

All the hydraulic machinery connected with the Liverpool Docks, with the exception of the Albert Dock machinery previously described, is worked upon this system. At the corn warehouses the accumulators are supplied by a horizontal high-pressure steam-engine of 370-horse power. There are two accumulators, with rams of 17 inches diameter, 17 feet of vertical range, and each carrying a load of 70 tons. Also an auxiliary accumulator with a ram of 20 inches diameter, a range of 23 feet, and a load of 100 tons. Power is transmitted from the accumulators to work the whole of the machinery in the warehouses, the lock machinery, and the bridges over the entrances, 12 sluices, 10 capstans, and 24 machines for opening and closing the lock gates. The supply of water is obtained from the Corporation mains, delivered into a tank erected over the engine. The exhaust water from the machines is conveyed by return pipes to a well in the engine-house and pumped up to the tank for further use.*

Under this system, water is not the prime mover, but is merely employed as a means of accumulating and transmitting power. It does not, therefore, come within the limits to which this paper is chiefly confined. I may, however, enumerate here some of the principal further uses to which this class of water-pressure machinery is applied.

In docks—for moveable cranes and jiggers, docking ships, opening and closing dock gates, swing bridges, sluices, coal hoists, ship capstans. At sea—for working heavy guns, for stearing gear. In railway yards—for waggon hoists, cranes, and capstans. For rivetting machines, flanging presses, and shop tools.

Any required pressure for driving shop tools, or special machines, may be obtained in a simple and economical manner by an intensifying accumulator, such as will be found described by Mr. Ralph H. Tweddell, in the Proceedings of the Institute of Mechanical Engineers for 1869.

The apparatus consists of a low-pressure cylinder with a piston, from which a ram works into a second or high-pressure cylinder. The pressure from the water-works main, or from an ordinary accumulator, being admitted into the first cylinder, the pressure in the second cylinder is increased in proportion to the difference between the area of the piston and that of the ram. In the instance referred to, the diameter of the piston was 19 inches, and of the ram 3¾ inches, so that a pressure of 60 lbs. in the first cylinder produced a pressure of 1540 lbs. in the second. The latter is fed by a pump, no water being consumed in the first.

In Hull, a private Company obtained parliamentary powers in 1872 to pump water from the River Humber for distribution along the line of docks as a motive power, for working dock gates, cranes, and other purposes. The works have recently been completed, at an outlay of £17,000. Nearly a mile of 6-inch cast-iron main, 1 inch thick, with gutta-percha ring joints, has been laid, through which water is supplied at a pressure of 610 lbs. per square inch. Two pairs of high-pressure horizontal engines, of 60-horse power each, capable of pumping 130 gallons per minute at 700 lbs. per square inch, with steam at 100 lbs., have been erected. They pump into an accumulator of 18 inches diameter and 20 feet stroke, loaded with 57½ tons of copper slag and sand. The Company supply the high-pressure water to the Hull Docks at the rate of 4s. per 1000 gallons. The charge for working warehouse cranes is under ½d. per ton for a lift of 40 feet.†

New and Extended Applications of Water Power.

There are many towns in England and on the Continent where water from the ordinary distributing mains is much more extensively used as a motive power than in Liverpool. As an instance I may mention Zurich in Switzerland, a town of about 20,000 inhabitants, where there are 113 water-engines, varying in size from ¼ to 4 horse power at work for various trade purposes. The average pressure in the mains is about 50 lbs. per square inch, and the charge for the water consumed is at the rate of 5d. per indicated horse power per hour.‡

If we consider the advantages which water power affords, especially where a constant supply can be relied upon, it appears evident, from the examples that have been given and the facts that have been adduced, that there is room for a more extensive application of it.

Among the advantages which may be claimed are the following:—

1. Steadiness, ease, precision, and comparative noiselessness of action.
2. Absence of risk from accident.
3. Facility with which the movement of a machine may be controlled from any point of its travel.
4. Simplicity of working, rendering the employment of skilled labour unnecessary.
5. Saving in charges for insurance, as compared with machinery involving the use of fire or light.
6. Limitation of the expenditure of power to the time during which useful work is being performed, thus enabling machinery to be employed intermittently without loss of power.
7. Ease with which energy may be transmitted to considerable distances without appreciable loss.
8. The opportunity afforded of making special provision for extinguishing fires, by attaching fire hydrants to the pipes laid to convey the water pressure.

But my object is not to advocate a further use of water for purposes of the same character, and under the same conditions, as those which at present obtain. The facts and figures which I have placed before you will enable you to form an independent opinion as to the economy and suitability of this particular kind of power for various classes of work, and therefore to determine under what circumstances it may be desirable to employ it. There is, however, one branch of the subject to which I desire to invite your attention, and that is to the practicability of deriving useful work from power which is now wastefully expended; and of obtaining greater efficiency from existing machinery, by a more careful study of the principles involved in its construction, and in the application of hydraulic power.

The total average weight of water distributed each day in Liverpool, by measurement through meter, for trade purposes, is 14,126 tons. At the average pressure under which the distribution of this volume takes place, it represents 1,907,010 foot tons. Of this volume no inconsiderable proportion is delivered at or near to the level of the ground, and the head of water is therefore almost entirely expended in producing a high velocity of discharge. Though in the majority of cases this may be necessary, and the same results could not be attained, together with any further utilization of the head, without enlarging the diameter of the supply-pipes, there are numerous instances where a steady flow throughout the day, or during a part of the day, at a low velocity, might be substituted for an intermittent flow at high velocity. An illustration will perhaps make this more apparent. A consumer receives through a 2-inch meter an average supply of 20,000 gallons per day, at a pressure in the main of 60 lbs. per square inch. It is delivered into a tank at an elevation of 10 feet above the ground. Here is an available head of 125 feet over and above the head required to carry the water to its destination, and an available energy of 114,285 foot-tons per day. What I suggest is, that in all such cases the pressure may be utilized to fill an accumulator or high-level tank, from which it may be transmitted to work any machinery within its range.

An ingenious machine has been introduced into Leeds, chiefly in woollen warehouses where there are numerous hydraulic presses, by Mr. Benjamin Walker, for obtaining a pressure of as much as 2500 lbs. per square inch from the water-works pressure of 40 to 70 lbs. The town pressure is admitted into a cylinder having a ram of 14 inches diameter and 8 feet stroke, acting upon another ram of only 1¾ inch diameter, the difference of area giving the required high pressure. The high pressure water is admitted to any of the hydraulic presses by simply turning a tap. When the contents of the cylinder have been expended, the ram is allowed to descend, and a fresh supply is obtained by simply working a slide-valve, an operation which can be performed by a boy. It will be obvious that there are many purposes to which an apparatus of this kind may be applied.

Economy of Construction.

An examination of the table on page 805 will show that the useful work derived from lifts and hoists is, in most of the examples, tabulated much under what is due to the pressure of water available; also, that the results obtained per foot-ton, multiplied by the pressure, vary to a remarkable extent.

The method of ascertaining the load in column 5, which has already been explained, must be kept in view; and regard must also be had to the fact that some of the machines were erected during a period when the supply to the town was intermittent, and when, in consequence of the increased demand upon the pipes during the hours of service, and the excessive waste that took place, the pressure of water was lower than it is at present. When allowance has been made for these circumstances, there still remains a difference between the power expended and the useful effect produced, considerably in excess of the loss usually assumed for friction. The co-efficient of effect for direct-acting machines of ordinary make should be about 90 per cent.; for machines multiplying six to one, a co-efficient of not less than 70 per cent. should be obtained; and for ten to one machines a co-efficient of not less than 50 per cent.

The defects in construction and erection are generally that platforms are made too heavy, and are not properly guided; imperfect packing; and badly-designed valves.

In the application of water pressure to organ blowing there is also considerable waste, arising from the imperfect and unskilful manner in which the power is taken from the engines. The principal causes of waste are—1. The feeders not being made of sufficient capacity. 2. The length of stroke being too great. 3. In one instance, only one piston of the two-cylinder engine has been connected, and thus one-half of the power is lost.

I have briefly indicated the direction in which useful work may be derived from energy that is at present unprofitably expended, and in which economy may be practised in the application of water pressure. That the possibility of reducing or preventing any loss that takes place in existing machinery has not received more consideration, is probably due to the fact that such loss is intermittent, and its money value per lift or per day very small.

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* For a full description of the hydraulic machinery in the Liverpool Corn Warehouses, *vide* Proceedings of the Institute of Mechanical Engineers, 1869.

† *Vide* Proceedings of the Institution of Civil Engineers, Vol. xlix., p. 2.

‡ *Vide* Proceedings of the Institution of Civil Engineers, Vol. xlix., p. 34.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The coal trade throughout this district continues in a very unsettled and depressed condition, and there is so much underselling going on in the market that it is difficult to ascertain what prices really are being taken. In the gas coal contracts which are now being given out, the competition is very keen, and in one case I have heard so low a price was quoted, that a stipulation was made that neither the figure, the quantity, nor the name of the firm should be made public. Colliery proprietors, however, as a rule, although they will take extremely low prices, decline to tender beyond the customary twelve months. Good Arley coal for gas-making purposes can be readily bought at the pit mouth for less than 8s. per ton, and common gas coal for 6s. per ton. For other descriptions of fuel the demand is very small. The better classes of round coal for house-fire purposes move off very slowly; common coal is, if anything, a greater drug than ever, there being very little inquiry either for shipment or home consumption, and engine classes of fuel are naturally being thrown upon the market in large quantities by the serious strike in the cotton trade. Prices generally have a downward tendency, and in the Oldham district reductions of 1s. 3d. per ton on best coal, and 10d. on burgy, have been made.

A very large proportion of the pits are not now running more than half time, and where they are kept fully going heavy stocks are accumulating. Notices have been served upon the miners in the Oldham district of a reduction in wages amounting to nearly 17 per cent.

The iron trade is still without improvement, and although there is a great deal of pushing at very low prices, this has little or no result in bringing forward new business, consumers, as a rule, only buying to cover their present extremely limited requirements. In the finished iron trade there is a great deal of competition for orders, and a contract for 6 and 4 inch water-pipes, delivered into the Heywood district, was placed last week at £5 5s. per ton. Ordinary Middlesbrough plates delivered into the Manchester district are pushed at £7 2s. 6d.; Middlesbrough and Lancashire bars are quoted at about £6 2s. 6d., and North Staffordshire bars are quoted at about £6 5s. per ton.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The shipments of Durham coals have continued to improve over three week. Last week showed an increase of shipments from the Tyne Docks of 1000 chaldrons. The week before showed a similar increase over the week preceding it. The best gas coal trade is pretty steady, and the leading collieries work an average number of days in the fortnight. Second-class Durham coals are a little firmer, and recent quotations of prices are maintained. The demand for steam coals in the Northumberland district is tolerably good, and the best collieries are working well up to ten days per fortnight. A fortnight ago there was a sudden rise of Baltic and Mediterranean freights; but they are down again. Cronstadt rates have fallen from £11 to £9 per keel. The demand for tonnage to be employed in the coasting trade is very poor. Steamers hardly get 4s. 6d. per ton for London, and sailing ships about 5s. 3d. There is literally nothing doing for the east coast, and very little for the British Channel. The chemical market is extremely flat, and prices have fallen for all articles. Pig lead is £17 7s. 6d. to £ 17 10s. per ton; dry white lead, £24; red lead, £18 15s.; copper is sold in cakes and ingots at £68 to £69; best selected, £72 per ton. The iron market is extremely dull. Pig iron is selling, local make, No. 1, 48s. 6d.; No. 3, 43s. 6d. net cash; Scotch warrants, 51s. 6d. per ton.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

In consequence of the proposal which was made some months ago by the Police Commissioners of Johnstone to take over the local gas supply undertaking not having been amicably arranged, the Gas Company have appointed Mr. Henry Green, Preston, as their arbiter.

The loan of £25,000, for the purchase of the gas-works at Alloa, under the provisions of the Burghs Gas Supply (Scotland) Act, has now been negotiated, and the money received. The loan is for 22 years, and the rate of interest is 4¼ per cent.

On the 13th inst. the Police Commissioners of Kirkintilloch sat as the Commissioners under the Burghs Gas Supply Act, when it was unanimously agreed that Mr. William Foulis, Manager to the Glasgow Corporation Gas Commissioners, should be appointed arbiter to act for the Commissioners in the reference between them and the Gas Company as to the valuation of the Company's works and plant. It was remitted to the Special Committee to make inquiries, and to consider and report as to obtaining a loan for the purchase of the undertaking.

The Directors of the Markinch Gas Company, Fifeshire, have resolved to recommend a dividend at the rate of 10 per cent. for the past year. A dividend of 6¼ per cent. has been declared by the Falkland Company, which is the same as that made last year. The Directors of the Aberfeldy Gas Company have declared a dividend of 5 per cent.

In his report on the illuminating power of the gas supplied in Glasgow during the week ending the 11th of May, Dr. Wallace states the minimum ranged from 25·42 candles to 27·72 candles, the average from 26·11 candles to 28·55 candles, and the maximum from 27·44 candles to 29·46 candles. The western district showed the highest results in all cases.

Mr. Alexander Mackellar, who has for a number of years been Secretary and Treasurer to the Greenock Corporation Gas Committee, has just been appointed to various public offices held by Mr. Adam, Town Chamberlain, who has retired from active service. The finances of the Gas Trust will still be controlled by the new Chamberlain.

At the meeting of the Town Council of Ayr, on the 13th inst., authority was given for obtaining the opinion of Counsel in regard to the arrangement that had formerly been entered into between the Council and the local Gas Companies on the question of the discount allowed on the public lamp account. It is understood that the Police Commissioners are in sore straits for cash, and that, in consequence, they are determined to do their best to maintain a right to a discount amounting to 30 per cent.

It was reported to a meeting of the Glasgow Corporation Water Commissioners, held last Thursday, that there were already 39 district water-meters in position, covering a population of 60,401. At the starting of the meters the average consumption per head was 53·1 gallons per day, and that it had since been reduced to 32·6 gallons per head per day, thus showing a saving of 20·5 gallons per head per day, or a total of 1,238,220 gallons per day. Steps are being taken for the formation of additional districts on the south side of the River Clyde, to be placed under the meter system for detecting and reducing waste of water.

Pig iron sold in the Glasgow market during the past week at as low as 49s 1d.; on Friday, however, there was an improvement, and the market closed with buyers at 49s. 3d. cash, and 49s. 5d. one month, though the price was still 4d. per ton under the closing price of the preceding Friday.

The coal market was rather disarranged during last week, through the idleness of the colliers; still very little inconvenience was experienced, as full supplies were forthcoming. The demand for most descriptions continues to be very limited, and as yet there is no appearance of better prices.

PURCHASE OF THE STAFFORD GAS-WORKS.—At the quarterly meeting of the Stafford Town Council on the 7th inst., a letter was read from the Local Government Board sanctioning the loan of £71,000 for the purchase of the gas-works.

GAS-WELL AT KANSAS.—The National Water-Works Company, Kansas City, Mo., whose works are located on the bank of Turkey Creek, in sinking an artesian well, have struck a copious gas stream at a depth of 247 feet. It is supposed that the gas reservoir or vein struck is the same as that on which the famous Wyandotte well is located. The gas will be used as fuel for the water-works, thus saving some 3000 dols. per year.

LAMPLIGHTING BY ELECTRICITY.—At the meeting of the Metropolitan Board of Works, on Friday last, a recommendation by the General Purposes and Sanitary Committee, that Mr. St. George Lane Fox be informed that his application for permission to test his system of gas lighting by electricity, by applying it to the lamps on the Victoria Embankment, will not be entertained, on the ground that the experiments now being made in Pall Mall will probably be sufficient, was unanimously approved.

SALE OF NEW RIVER SHARES, ETC.—At the Auction Mart, on the 15th inst., Messrs. Fox and Bousfield offered to auction freehold estates in the New River Company, comprising—One-fourth of an Adventurer's share, one-fourth and one-fifth of a King's share, also 31 New shares, and 28 Annuities of £2 10s. each for 208 years. The Adventurer's shares realized at the rate of £93,200 per share, the King's share at the rate of £90,000 per share, the New shares an average of £332 5s. per share, and the Annuities £63 each.

WASTE OF WATER AT DORCHESTER.—An extraordinary waste of water in this town has been revealed by the survey of Messrs. Gotto and Beesley, of Westminster. It appears that from twelve o'clock at night to six in the morning there has passed out of the reservoir 76,680 gallons of water, representing a waste equal to nearly 40 gallons per head per day on a population of 7500. Messrs. Gotto and Beesley state the supply has been more lavish than that of Glasgow, with Loch Katrine flowing by gravity into the city. The estimate for new water-works, including the extension for Fordington, a part of the borough, is £17,877.

NEW SEAM OF SCOTCH GAS COAL.—The *Edinburgh Daily Review* says: "A new seam of gas coal in the Airdrie district has just been brought into the market by the Drumbowie Coal Company, Glasgow. It is a coal very rich in gas-producing elements, and with a first-class coke. The seam, which is well known in the district, is very erratic in its appearances, being met with now and again in various quarters in the Lower Ward of Lanarkshire, and disappearing again suddenly. From present appearances, the yield of the seam now being worked will be about 50 tons per day, and as indications have been got of its continuance over a wide area, it is likely to last for some time.

QUALITY OF THE GAS SUPPLIED TO CAMBRIDGE.—At the last meeting of the Cambridge Town Council, Mr. W. E. Pain, the gas tester, presented the following report:—"During the quarter ending on the 31st of March I made the usual test twice daily of the illuminating power of the gas supplied to this borough, with the following results:—The average of January was 14·90 candles, February 15·01, and March 14·90 candles. The whole of the observations (167 in number) were above the standard of 14 candles, with the exception of the evening of the 13th of March, which was equal to the standard. The sulphur and ammonia tests were also satisfactory, the Letheby apparatus giving 16·37 grains of sulphur per 100 cubic feet, being 3·63 grains below the minimum quantity allowed. The pressure has been maintained throughout the quarter in an efficient manner."

QUALITY OF THE NEWCASTLE-ON-TYNE GAS.—Mr. John Pattinson reports the following as the results of his examination, for the last month, of the quality of the gas supplied to the borough by the Newcastle-on-Tyne and Gateshead Gas Company:—

Date, 1878.	Illuminating Power in Sperm Candles.	Grains of Sulphur in 100 Cubic Feet of Gas.	Sulphuretted Hydrogen.
April 2	15·1	6·94	Nil.
„ 5	15·3	7·27	„
„ 9	14·6	6·64	„
„ 12	14·2	5·40	„
„ 16	15·5	4·52	„
„ 18	14·3	5·08	„
„ 23	15·7	5·61	„
„ 26	14·8	5·98	„
„ 30	13·8	6·19	„

A Sugg-Letheby standard Argand burner is used in testing. According to Act of Parliament, the gas should not be of less than 14 standard candles illuminating power, nor contain more than 17 grains of sulphur per 100 cubic feet of gas.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

1687.—CLARK, A. M., Chancery Lane, London, "An improved pump." A communication. April 26, 1878.

1710.—COMOLLI, L. A., Valenza, Italy, "Improvements in means or apparatus for obtaining light." April 29, 1878.

1711.—EVANS, J., Wolverhampton, Stafford, "Improvements in steam-pumps and other motive-power engines and pumps, applicable also to valves for other purposes." April 29, 1878.

1714.—ENGEL, F. H. F., Hamburg, Germany, "Improvements in valves for pumps." A communication. April 29, 1878.

1724.—FOSBERY, G. V., Beckenham, Kent, "Improvements in and relating to pumps." April 30, 1878.

1754.—MICHEL, C., and FRAGER, A., Paris, "Improvements in water-meters." May 1, 1878.

1757.—BRICKNELL, A. L., Southampton Buildings, London, "Improvements in means for joining the ends of lead pipes to each other, and for connecting fittings to such pipes." May 1, 1878.

1764.—CUTLER, S., Millwall, London, "Improvements in apparatus used in the manufacture of gas." May 2, 1878.

1770.—ABEL, C. D., Southampton Buildings, London, "Improvements in apparatus for igniting the charges of gas motor engines." A communication. May 2, 1878.

1844.—ASHWORTH, G. K., Halifax, Yorks, "Improvements in valves or taps used for steam, water, gas, or other liquid or fluid, such valve or tap being specially applicable for tallow-cups for lubricating purposes." May 8, 1878.

1859.—ARUNDEL, G., Sheffield, "Improvements in water-taps." May 9, 1878.

1860.—ABEL, C. D., Southampton Buildings, London, "Improvements in hydraulic mains, stand-pipes, and other conduits or receptacles for gas employed in the manufacture thereof." A communication. May 9, 1878.

1861.—SIMON, H., Manchester, "An improved blowing machine applicable for drawing or forcing fluids." A communication. May 9, 1878.

1796.—CAHILL, J., Dublin, "An improved method of preventing the escape of sewerage effluvia from rivers into which sewers are discharged, and for utilizing the flow of tides for the purpose of flushing such sewers." May 4, 1878.

1798.—HALLEWELL, R., Blackburn, Lancs, "Improvements in gas-engines, applicable in part to other uses." May 4, 1878.

1889.—MOLISON, A. R., Swansea, Glamorgan, "Lighting ordinary coal-gas jets by electricity." May 10, 1878.

1921.—BLACKWELL, W., Dalton-in-Furness, Lancs, "An automatic balance-pump." May 14, 1878.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

4012.—OUTRIDGE, J. E., Egham, Surrey, "Improvements connected with steam and other engines and pumps." Oct. 29, 1877.

4028.—HUGHES, E. T., Chancery Lane, London, "Improvements in pumps." A communication. Oct. 30, 1877.

4118.—Spence, P., Manchester, "Improvements in the treatment of spent oxide of iron arising from the manufacture of gas, for the purpose of obtaining certain valuable products, and for rendering the said oxide again fit for use." Nov. 5, 1877.
4134.—Mills, B. J. B., Southampton Buildings, London, "Improvements in the manufacture of gas for lighting and heating purposes." A communication. Nov. 6, 1877.
4154.—Howard, J., Erith, Kent, Wilson, A. F., and Kingdom, H. W. A., Southwark, London, "Improvements in automatic apparatus for regulating the flow of liquids under pressure, and prevention of waste of water." Nov. 7, 1877.
4156.—Hart, A. H., and Potter, J. J., Birmingham, "Improvements in valves for liquid, steam, and gas pipes." Nov. 7, 1877.
4202.—Shobey, F. W., Poplar, London, "Improvements in valves." Partly a communication. Nov. 9, 1877.
4217.—Nawrocki, G. W. von, Berlin, "Improvements in meters for measuring liquids." A communication. Nov. 10, 1877.
4222.—Bangs, D. E., and Burnett, W., Boston, U.S.A., "Improvements in 'carburetters.'" Nov. 12, 1877.
4249.—Newton, H. E., Chancery Lane, London, "Improvements in gas-regulators." A communication. Nov. 13, 1877.
4286.—Kidd, J. H., Wrexham, Denbigh, "Improvements in treating excreta, house refuse, and sewage sludge, to obtain manure and other useful products therefrom, and in arrangements and apparatus to be employed therein." Nov. 16, 1877.
4332.—Forbes, J., and Abbott, J., Old Ford, London, "Improvements in apparatus used in the distillation of coal, for the production of coke, tar, and ammoniacal liquor, and the utilization of the resulting gases." Nov. 19, 1877.
4420.—Kronschröder, J. F. G., Walthamstow, Essex, "Improvements in means or apparatus for carburetting and purifying coal gas." Nov. 23, 1877.
4452.—Wise, W. L., Adelphi, London, "Improvements in lighting apparatus." A communication. Nov. 26, 1877.
4536.—Wirth, F., Frankfort-on-the-Maine, Germany, "Improvements in purifying water." A communication. Dec. 1, 1877.
4594.—Platt, J., St. Martin's Lane, London, "An improved automatic gas-stove for heating irons." Dec. 4, 1877.
4643.—Davies, W., Liverpool, "Improvements in regulating, controlling, or measuring the supply of liquids for water-closets and for other purposes, and in apparatus therefor." Dec. 7, 1877.
4769.—Abel, C. D., Southampton Buildings, London, "Improvements in the treatment of hydrocarbons for their purification and conversion into other products." A communication. Dec. 15, 1877.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, and TWO MEDALS at the PHILADELPHIA EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

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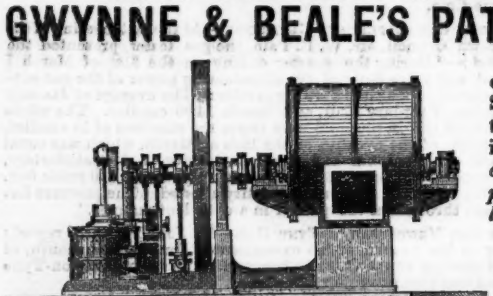

EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

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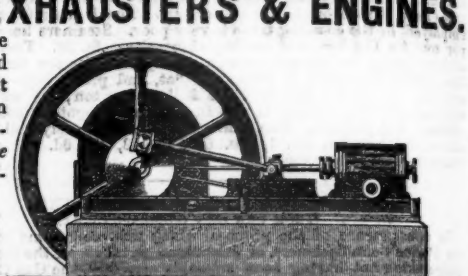

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GEORGE WALLER & CO.

MAKERS OF ENGINES, EXHAUSTERS, INDEX AND DISC GAS-VALVES, HYDRAULIC MAIN VALVES, BYE-PASS VALVES, TAR, LIQUOR, AND OTHER PUMPS, SCRUBBERS AND PURIFIERS, CONDENSERS, BOILERS, &c.

Awarded Silver Medal at the Manchester Exhibition of the Society for the Promotion of Scientific Industry.

Phœnix Engineering Works:

HOLLAND STREET, SOUTHWARK, S.E.

TO GAS ENGINEERS.

D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS, BONNINGTON, EDINBURGH.

WANTED, a Gas-Fitter and Service LAYER, capable of Repairing Meters, Wet and Dry.

Apply, in own handwriting, stating wages required, and copy of certificate for good character and workmanship indispensable, to No. 455, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a thoroughly practical man, aged 42, a situation as MANAGER or SUB-MANAGER of Gas-Works. First-rate testimonials.

Address No. 454, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Gas-Maker who thoroughly understands Gas-Making, and can take entire charge of a small Gas-Works, take Meters, and collect Accounts. Good references required. Wages 24s. per week, with house, coal, and gas.

Address Milnthorpe Gas, Coal, Coke, and Lime Company, Milnthorp, WESTMORELAND.

WANTED, a Competent Person as STOREKEEPER and CLERK for a Gas-Meter Works in London; to live on the premises. Salary £100 per annum.

Address, by letter only, Imperial Meter Company, Limited, 115, Victoria Street, WESTMINSTER, S.W.

A Young Man, aged 22, who has jus finished a four years engagement with a provincia Gas Company is open to take a situation as Manager of small Gas-Works, or as Assistant to the Engineer of large Works. Can give first-class testimonials. Has no objection to go abroad.

Address No. 460, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GRAND JUNCTION WATER-WORKS COMPANY.

THE Court of Directors of the Grand Junction Water-Works Company propose to appoint an officer under the title of SURVEYOR and SUPERINTENDENT of WATER-RENTALS, &c., with a salary of £350 per annum and an official residence, with coals and light, at their district office.

The duties of the office will include the Supervision of all Valuations and Assessments, and of the correctness of the Water-Rentals charged by the Company, likewise of the Domestic House Services and of the Meters and Meter Services, together with a control over all Fittings, such as ferrules, ball-taps, &c., and the performance of all other acts and duties in connection with the above matters which may, under any order of the Court, be required.

Applications, with copies of testimonials, to be addressed to E. O. Coe, Esq., Secretary, at the Company's Offices, 6, South Molton Street, London, W., on or before the 1st of June next.

By order,
E. O. COE, Secretary.

May 1, 1878.

ON SALE—One Station-Meter, to pass 1000 cubic feet per hour. Almost new. Will be sold cheap.

Apply to J. HALL, Gas-Works, St. Helen's, LANCS.

GASHOLDER, now at work, and in good condition, FOR SALE; 45 ft. diameter, 18 ft. deep; Six Columns and Girders, with Chains and Balance-weights.

Apply to the Horseley Company, Limited, Tipton, STAFFORDSHIRE.

TO BE SOLD—Colyton Gas-Works, Devonshire.

For price and particulars, apply to J. W. DAVIS, George Street, HULL.

ON SALE—A Station-Meter (with new Drum), capable of passing 10,000 cubic feet per hour, with Hydraulic Valves, Bye-Pass, &c.; 10-in. Connections. Has been removed to make room for one of larger capacity.

For particulars and price, apply to GEORGE NEWTON, Gas-Meter Manufacturer, Union Street West, OLDHAM.

FOR SALE, One New 6-inch Centre- VALVE, by Messrs. C. and W. Walker (patent), with service connections. Has not been fixed.

One STATION-METER, by Messrs. J. and J. Braddock, Oldham, for 6-inch connections, to pass 8000 feet per hour. Has been in work five years; in first-class condition.

For particulars, apply to HENRY CLARKE, Secretary, Gas Company, Maldon, ESSEX.

TO GAS COMPANIES AND BROKERS.

THE Radcliffe and Pilkington Gas Com- pany have ON SALE the following Apparatus, &c., viz.:—

One Vertical High-pressure Steam-Engine, 6-in. cylinder, 12-in. stroke, with Fly-Wheel and Pump complete.

Two 10-in. Exhausters, 12-in. cylinders, 16-in. stroke, with Horizontal Steam-Engine attached, 7-in. cylinder, 12-in. stroke; one Governor; one set of 9-in. Condensers; two 10-in. overground Valves; two 10-in. underground Valves; all nearly new, by Dempster, of Elland.

Two 7-in. Exhausters, 15-in. stroke; three Valves, 7 in.; and one 7-in. Bye-pass Valve.

One 18-in. Governor, with three 18-in. Valves.

One 12-in. Governor, with inlet, outlet, and bye-pass Trap-Boxes.

One Station-Meter, 6 ft. by 4 ft., by Barnes and Roper, Wigan.

One four-way 12-in. Centre Valve, with Lifting Gear for purifiers, and all Connections to and from the purifiers.

One set of 8-in. Condensers.

One set of 7-in. Condensers.

90 D Retorts, iron mouthpieces, 16 in. by 14 in.

A quantity of old metal.

The materials offered may be inspected at the works of the above Company, Sion Street, Radcliffe, near Manchester, and all information may be obtained from the Company's Manager.

The whole of the above-named materials are open for sale by private treaty, and if not so disposed of will be sold by public auction.

By order,
JNO. BRANDWOOD, Manager and Secretary.
Gas-Works, Radcliffe, May 3, 1878.

GODALMING GAS-WORKS.

A Set of Three 6-feet Square Purifiers, Sieves, Lifting-Gear, and Centre-Valves, all complete, in good condition, and have been in constant work up to the 15th inst. (made by Cockey and Son, Engineers, Frome), are now for sale, larger ones having been erected.

To be taken down and removed at the purchaser's expense.

For further particulars, apply to Mr. A. COLPUS, Secretary.

THE Kidderminster Gas Company are prepared to receive TENDERS for the AMMONIACAL LIQUOR produced at their Works from August 1 next, for a period of One or more years.

Tenders to be lodged with the Manager on or before the 1st day of June.

Kidderminster, May 17, 1878.

THE Trustees for the District and Har- bour of Maryport are prepared to receive TENDERS for the Purchase of the AMMONIACAL LIQUOR made at their Gas-Works for One year, commencing on the 1st of July next; and also for the Purchase of the Surplus TAR made at the said Gas-Works for a like term. Both to be delivered into the purchaser's barrels at the Gas-Works.

The Trustees are not bound to accept the highest or any tender.

Sealed tenders, endorsed "Tender for Tar," or "Tender for Ammoniacal Liquor," as the case may be, to be sent to the undersigned, on or before the 1st day of June next.

JOHN BARWISE, Clerk to the Trustees.

Harbour Office, Maryport, May 14, 1878.

THE Directors of the Rochester, Chat- ham, and Strood Gaslight Company have for disposal two six-horse Engines and Boilers, recently thrown out of use, and about 150 Retort Mouthpieces, Ovals, 21 in. by 15 in.; and Rounds, 15 in. by 15 in.; with Outlets for 6-in. Ascension Pipes.

The articles may be seen on application at the Office.

Prepared for the whole or any part of the above, marked "Tender for Materials," may be sent not later than Wednesday, June 12, addressed to the Secretary, at the Office, 56, High Street, Rochester.

The Directors do not bind themselves to accept the highest or any tender.

WILLIAM SYMS, Secretary.

May 17, 1878.

TENDERS FOR AMMONIACAL LIQUOR.

THE Gas Committee of the Dewsbury Corporation are prepared to receive TENDERS for One, Two, or Three years (as may be agreed upon) for the purchase of the AMMONIACAL LIQUOR produced at their new Gas-Works, Savile Town, which are situated close to the canal. Quantity of Coals carbonized about 13,000 Tons per annum.

Any further information may be had on application to the undersigned.

Sealed tenders, endorsed "Tender for Ammoniacal Liquor," to be sent to Jesse Smith, Esq., Town Clerk, on or before the 11th day of June next.

The Committee do not bind themselves to accept the lowest or any tender.

CHAS. ARMITAGE, Engineer and Manager.

Gas-Works, Dewsbury, May 11, 1878.

ROSSENDALE UNION GAS COMPANY.

TENDERS are invited for the Supply of COAL and CANNEL for a term of One, Two, or Three years, from the 30th day of June next.

Quantity required per annum, about 9000 Tons of Coal and 5000 Tons of Cannel.

Tenders to be sent in not later than June 1, 1878, and addressed to the Chairman of the Gas Company, endorsed "Tender for Cannel and Coal."

WILLIAM BLACKLEDGE, Manager.

Cloughfold, near Manchester, May 6, 1878.

COAL CONTRACT.

THE Gas Committee of the Carnarvon Corporation are prepared to receive TENDERS for the Supply of 2000 Tons of Best GAS COALS, to be delivered during Twelve months ending July 31, 1879. Rate of delivery as per orders of Manager.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, Guildhall, Carnarvon, to be sent in not later than the 31st of May inst.

Further information may be obtained on application to
MAT. J. PARSONS, Manager.

Carnarvon, May 8, 1878.

BOROUGH OF HAVERFORDWEST.

THE Haverfordwest Town Council are prepared to receive TENDERS for their Surplus Stock of TAR, consisting of about 7000 Gallons.

Tenders, endorsed "Tender for Tar," to be sent to Wm. Williams, Esq., Mayor, on or before the 28th inst.

The Town Council do not bind themselves to accept the highest or any tender.

For further particulars apply to the undersigned.

J. GIBBON, Manager.

Gas-Works, Haverfordwest, May 11, 1878.

TO COAL PROPRIETORS.

THE Directors of the Cheltenham Gas- light and Coke Company invite TENDERS for the Supply of the best quality of COAL for making Gas, for Twelve months, from the 1st of July next.

For quantities, particulars, and conditions of contract, application to be made to the Company's Engineer.

Sealed tenders, addressed to the Engineer, must be forwarded on or before Thursday, the 23rd inst.

R. O. PATERSON, Engineer.

Gas-Works, Cheltenham, May 10, 1878.

AMMONIACAL LIQUOR.

THE Directors of the Barnsley Gas Com- pany are prepared to receive TENDERS for the AMMONIACAL LIQUOR produced at their Works in Barnsley and at Old Mill, for a period of One, Two, or Three years, from the 1st day of July next.

Probable quantity, and any other particulars, may be had on application to the undersigned.

Tenders, addressed to the Chairman, to be sent to me not later than Thursday, June 6, 1878.

JOHN HUTCHINSON, Manager.

Gas Office, Barnsley, May 13, 1878.

TO COLLIERY PROPRIETORS AND COAL FACTORS.

THE Joint Committee of the Dukinfield and Denton Joint Gas-Works invite TENDERS for the Supply of 8000 Tons of Staveley, Wigan, Yorkshire, or other good GAS COAL, and 2000 Tons of Wigan SCREENED CANNEL, or other approved description, to be delivered during One year, from July 1, as required by their Gas Manager.

Forms of tender and full particulars can be obtained on application to Mr. Bridge, Gas Offices, Dukinfield.

By order of the Joint Gas Committee,
WILLIAM BRIDGE, Gas Manager.

Gas Offices, Dukinfield, near Manchester.

TO CHEMICAL MANUFACTURERS, TAR DISTILLERS, AND OTHERS.

THE Gas Committee of the Dukinfield and Denton Joint Gas-Works are prepared to receive TENDERS for the Purchase of their Surplus TAR and AMMONIACAL LIQUOR for One year, ending July 31, 1879, or such term of years as may be agreed upon. The Committee will deliver the same into boats, free of charge, at their Dukinfield Works; boats to be provided by the Contractors.

Tenders to state price per Ton for Tar and Liquor separately.

Further particulars on application to Mr. Bridge, Gas Offices, Dukinfield.

Sealed tenders to be sent to me not later than May 28, 1878.

By order of the Joint Gas Committee,
WILLIAM BRIDGE, Gas Manager.

Gas Offices, Dukinfield, near Manchester.

TENDERS FOR GASHOLDER.

THE Directors of the Ackworth, Featherstone, Purston, and Shariston Gas Company, Limited, invite TENDERS, with plans and specification, for the completion of a Single-Lift GASHOLDER, 60 ft. diameter, and 16 ft. deep. When completed, with inlet and outlet pipes, 9-inch diameter, and necessary valves and connections, to be fixed at their Works at Purston, near Pontefract.

Tenders to be sent in on or before Monday, June 3, 1878.

The lowest or any tender not necessarily accepted.

JOSEPH WATSON, Secretary.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the Supply of 20,000 Tons of Staveley, Yorkshire, or any other good GAS COAL, to be delivered between the 1st of August next, and the 30th of June, 1879, either at Walsall Railway Station or by boat at Walsall Old or New Gas-Works; in the latter case it will also have to be unloaded and stacked in the coal-shed, or such other place at the Gas-Works as may be directed.

The Coal will have to be delivered at the rate of from 180 to 700 Tons per Week, as the Corporation may from time to time require. The weight, if delivered by rail, must be 2352 lbs. to the ton; if by boat, it must be 22 cwt. to the ton, boat gauge.

Payments monthly.

The Corporation do not bind themselves to accept any tender, and they reserve the right to divide the contract between several firms.

Tenders sealed, and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts (and also stating the price if delivered on the Corporation siding at the New Gas-Works instead of at Walsall Railway Station), are to be sent to the undersigned, on or before Thursday, the 6th of June next.

SAMUEL WILKINSON, Town Clerk.

Bridge Street, Walsall, May 16, 1878.

CONTRACTS UNDER THE LEEK IMPROVEMENT ACT, 1855.

THE Leek Improvement Commissioners invite TENDERS in respect of the following Contracts:—

No. 1. For the Purchase by them of a Supply of Best GAS COAL, screened over an inch screen, for One, Two, or Three years, from the 1st of July next, to be delivered at the Leek Station on the North Staffordshire Railway, at such times and in such quantities as may be required. Annual consumption 3500 to 4000 Tons.

Sealed tenders, endorsed "Tender for Gas Coal," and addressed to the "Chairman of the Gas Committee," must be received by Four o'clock p.m., on Tuesday, the 4th of June next.

The lowest or any tender will not necessarily be accepted.

No. 2. For the sale by them of the Gas Tar and Ammoniacal Liquor produced at their Works for One, Two, or Three years, from the 1st of July next, at per Ton of 2240 lbs. at such Works.

Sealed tenders, endorsed "Tender for Gas Tar and Liquor," and addressed to the Chairman of the Gas Committee, must be received by Four o'clock p.m., on Tuesday, the 4th of June next.

The highest or any tender will not necessarily be accepted.

Further particulars may be obtained from the undersigned.

By order of the Commissioners,
C. HENSHAW, Clerk.

Public Offices, Leek, May 15, 1878.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Directors of the West Kent Gas Company invite TENDERS for the whole of the AMMONIACAL LIQUOR and Surplus TAR produced at their Works at Erith and Crayford, for One, Two, or Three years, as may be agreed upon.

Tenders will be received up to the 31st inst., and the Directors do not bind themselves to accept the highest or any tenders. Quantity say 20,000 Gallons at each Works.

At Erith Works the Tar and Liquor will be pumped into Contractor's barges, at Crayford Works filled into Contractor's casks.

Tenders, endorsed separately "Tender for Tar," "Tender for Ammoniacal Liquor," to be forwarded to me, the undersigned, at the Company's Offices, 237, Southwark Bridge Road, London, S.E.

R. PEAKE KEYS, Secretary.

SPENT OXIDE OF IRON.

WE are open to Buy this in any quan- tity.

Address, with price, to NICHOLSON AND SONS, Chemical Works, Hunslet, near LEEDS.

SULPHATE OF AMMONIA PLANT.

THE Plant erected, or Plans supplied for above, on the newest and most improved method, at less than half the cost of other plans, gives better results, requires less labour, and allows no gases or offensive smell to escape. Reference kindly permitted to manufacturers as to efficiency and cheapness of plant, &c.

For particulars, address JOHN G. HARVEY, Chemical Works, Little Island CORK.

THE MAGHULL GAS COMPANY, LIMITED.

THE Directors of the above Company are prepared to receive TENDERS for the Erection of GAS-WORKS at Maghull.

Contract No. 1.—Erection of Manager's House, Coal Stores, Retort-House, Purifier-Shed, and other Buildings.

Contract No. 2.—The excavation and brickwork of a Gasholder-Tank.

Contract No. 3.—All Ironwork, Retorts, Fittings' Hydraulic Main, Condensers, Washer, Purifiers, Gasholder, &c., and all connecting Pipes and Valves.

The drawings and specifications may be seen on and after the 27th inst., and tenders must be delivered at the Secretary's Office, Maghull, Liverpool, on or before the 3rd of June.

Further particulars may be obtained from Mr. J. T. HALL, Engineer, Prescot.

The Directors do not bind themselves to accept the lowest or any tender.

By order.

Maghull, Liverpool, May 11, 1878.

TO IRONFOUNDERS.

THE Gas Committee of the Corporation of Salford invite TENDERS for the Supply of 1000 Yards of Cast-Iron GAS-PIPES, 18 in. diameter; 1000 Yards of 3 in. ditto, and 1000 Yards of 8 in. ditto, coated by Dr. Smith's process, with turned and bored joints, and with the bright parts covered with tallow and white lead, and to be delivered in such parts of the districts of Salford, Broughton, and Pendleton as may be desired by the Committee.

Particulars as to weights, strength, and lengths, and other information, may be obtained from the Engineer, Mr. Samuel Hunter, Lamb Lane Gas-Works, Salford.

Tenders, endorsed "Gas-Pipes," must be delivered to me on or before Saturday, the 25th inst.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
CHRIS. MOORHOUSE, Town Clerk.

Town Hall, Salford, May 16, 1878.

PATRONIZED BY THE ROYAL ARSENAL, WOOLWICH.

FERGUSON, Builder and Contractor. Kite method of Repairing Church Spires and High Chimneys. Chimneys straightened, pointed, and hooped. Old Chimneys pulled down by a process requiring no scaffolding or stoppage of work, by competent workmen under personal supervision. For Lightning Conductors—cheapness and method of fixing—apply to C. R. FERGUSON, 12, Canal Road, MILE END.

TO GAS ENGINEERS AND IRONFOUNDERS.

THE Directors of the Thrapstone Gas Company are prepared to receive TENDERS for a Condenser, Scrubber, Purifiers, Valves, and Connections, according to plans and specifications which may be seen on application to Mr. William Ibbs, Secretary, Thrapstone. Particulars may also be obtained on application to Mr. John Eunson, C.E., Northampton.

Tenders endorsed "Tender for Apparatus," addressed to Mr. William Ibbs, to be delivered on or before Saturday, June 1.

The Directors do not bind themselves to accept the lowest or any tender.

WILLIAM IBBS, Secretary.

May, 1878.

BOROUGH OF HALIFAX.

TO COLLIERY PROPRIETORS.

THE Gas-Works Committee invite TENDERS for the Supplying of 20,000 Tons of GAS COAL and 1000 Tons of CANNEL, to be delivered upon the Railway Siding at the Corporation Gas-Works. The whole to be supplied before April 30, 1879.

Printed particulars and forms of tender may be obtains on application to Mr. Wm. Carr, Engineer, Gas-Works, Halifax.

Tenders, properly endorsed, must be sent to me on or before Thursday, the 30th of May, inst.

By order,
A. C. FOSTER, Town Clerk.

Town Hall, Halifax, May 3, 1878.

COAL CONTRACT.

THE ABINGDON GASLIGHT AND COKE COMPANY, LIMITED.

THE Directors of the above Company are prepared to receive TENDERS for the Supply of 1500 Tons of GAS COAL, the deliveries to extend to One year, from the 1st day of August next.

Tenders, quoting price per Ton, delivered free at the Great Western Railway Station, Abingdon, must be delivered before the 4th of June next to the Secretary and Manager, Mr. JOHN ELY, Gas-Works, Abingdon, from whom any further information may be obtained.

Abingdon, May 10, 1878.

TAR AND AMMONIACAL LIQUOR CONTRACT.

THE ABINGDON GASLIGHT AND COKE COMPANY, LIMITED.

THE Directors of the above Company are prepared to receive TENDERS for the Surplus TAR and AMMONIACAL LIQUOR produced at their Works (which can be delivered into boat on the River Thames) for One or Two years.

Tenders, quoting price per Ton, must be sent in by the 4th of June next to the Secretary and Manager, Mr. JOHN ELY, Gas-Works, Abingdon, from whom any further information may be obtained.

Abingdon, May 10, 1878.

BOROUGH OF BURY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Corporation of Bury are prepared to receive TENDERS for GAS COAL and CANNEL for One, Two, or Three years, commencing on the 1st of August next, to be delivered free at the railway siding, Buckley Wells, or at the Corporation siding, Town's Yard, Fernhill, as may be required. Estimated quantity about 14,000 Tons of Coal and 3000 Tons of Cannel per annum.

Further particulars may be obtained at the Gas-Works, Elton, near Bury.

Tenders, endorsed "Tender for Coal and Cannel," stating the colliery from whence the fuel is proposed to be supplied, to be sent to me, the undersigned, on or before Wednesday, the 29th inst.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
FREDK. BULL, Town Clerk.

Corporation Offices, Bury, May 10, 1878.

BRISTOL UNITED GASLIGHT COMPANY.

SPECIFICATION AS TO SUPPLY OF COALS.
EXTENSION of TIME for DELIVERY of TENDERS.

THE Directors of the Bristol United Gaslight Company invite TENDERS for the Supply of from 90,000 to 100,000 Tons of GAS COALS, during the Twelve months between the 1st of July, 1878, and the 1st of July, 1879, for use at the Works, situate respectively at Avon Street, St. Philip's, and Canon's Marsh, Bristol.

The Coal to be partly small and partly large or brush, and to be delivered in such monthly proportions as may be required in accordance with the season. The quality of the Coals must be good, dry, and free as possible from sulphur, bats, bind, refuse, and dirt.

Full particulars required of the Coals for which tenders may be submitted; and the Directors will be glad to receive chemical analyses thereof, and any information in relation to their properties for the manufacture of gas.

Parties tendering must state the maximum quantities of either small, large, or brush Coal they will undertake to deliver monthly, and it must be understood that the Directors are to be at liberty to accept the terms offered for any lesser quantities they may think fit.

Tenders to state the prices per ton f.o.b. (port of shipment to be named), or delivered at the Railway Station, Bristol, or at the Company's Gas-Works, Avon Street, or Canon's Marsh, and discount for cash monthly payments.

Payment will be made in accordance with the weight (20 cwt. to the Ton), as weighed upon the weigh-bridge of the Gas Company at their respective Stations.

Sealed tenders, to be addressed to the Chairman of Directors, Bristol United Gaslight Company, Canon's Marsh, Bristol, marked "Tender for Gas Coal," and delivered not later than TUESDAY, the 4th of JUNE NEXT.

HENRY H. TOWNSEND, Secretary.

Gaslight Offices, Bristol, May 9, 1878.

Now Ready, price 28s., handsomely bound in Morocco, cloth sides, gilt edged and lettered,

THE FIRST VOLUME
OF
KING'S TREATISE
ON THE
SCIENCE AND PRACTICE OF THE MANUFACTURE & DISTRIBUTION
OF
COAL GAS.

EDITED BY THOS. NEWBIGGING, C.E., M.INST.C.E., AND W. T. FEWTRELL, F.C.S.

This Volume contains 460 pages of Letterpress, and is illustrated by 521 Woodcuts and 36 page and double-page Engravings, printed on Plate paper, and a full-page

COLOURED ENGRAVING OF THE BECKTON GAS-WORKS,

Forming a Frontispiece to the Volume.

ORDERS RECEIVED BY THE PUBLISHER,
WILLIAM B. KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

JOHN ABBOT & CO., LIMITED,
MANUFACTURERS OF
IMPROVED
HYDRAULIC CRANES & HOISTS,
Effecting an IMMENSE SAVING in the cost of discharging Coals from Vessels, Barges, &c.

HYDRAULIC RAMS FOR LIFTING AND LOWERING PURIFIER COVERS.
GAS PLANT GENERALLY, PIPES, ROOFING, TANKS, &c.,

PARK WORKS, GATESHEAD.

LONDON OFFICES:
2, SUFFOLK LANE, CANNON STREET, E.C.

GLASGOW OFFICES:
54, ST. ENOCH'S SQUARE.

WILSON CARTER AND PEARSON,
GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

Address—CHIEF OFFICES:

TEMPLE BUILDINGS, 50, NEW STREET, BIRMINGHAM.

ECONOMY IN THE PRODUCTION OF GAS.

PLUTONIC CEMENT,

For Jointing and Repairing Retorts and Ovens *in* action and *out* of action.

A Pamphlet on the advantages of the above, with modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, GAS AND HYDRAULIC ENGINEER,

CHARLES HENRY STREET AND BISSELL STREET, BIRMINGHAM.

THE THAMES BANK IRON COMPANY,
(Successors to LYNCH WHITE,)

SUPPLY FROM STOCK

CAST-IRON RETORTS, SOCKET-PIPES for GAS or WATER PURPOSES, FLANGE-PIPES for STEAM, RAIN-WATER PIPES and GUTTERS, HOT-WATER PIPES and BOILERS, and all requisite Connexions for same; also LAMP-COLUMNS, LAMPS, WROUGHT FRAMES, WROUGHT-IRON TUBING, &c., &c.

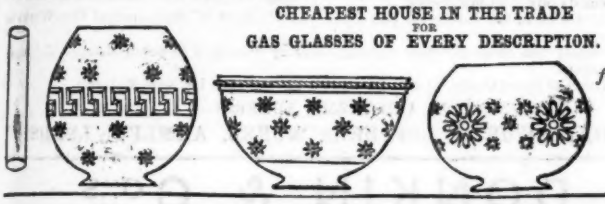
All kinds of Gas-Works Apparatus and General Castings made to Pattern or Drawing.

ADDRESS—

OLD BARGE WHARF, UPPER GROUND STREET, LONDON, S.E.

COMMERCIAL GLASS WORKS, 27, WELLCLOSE SQUARE, LONDON, E.

CHEAPEST HOUSE IN THE TRADE FOR GAS GLASSES OF EVERY DESCRIPTION.



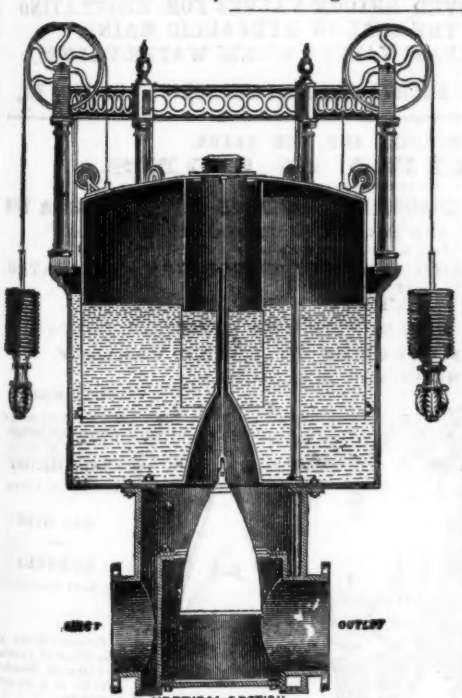
Write for Lists, free on application to any part of the World.

J. & J. BRADDOCK,
GLOBE METER-WORKS,
OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

WANTED, Readers of the Pamphlet, "Cooking and Heating by Gas; on Burners," &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, Gas-Works, SYDENHAM, S.E.

WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.

John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

WANTED, Orders for Samples to test the superior Silkstone, Wigan, and other Gas Coals and Cannel on Sale by G. J. EVERSON, Gas Coal and Cannel Contractor, BIRMINGHAM.

N.B.—Prices on personal application, or by post or telegram, on shortest notice, and prompt delivery.

W. LIDDALL,
PUBLIC ACCOUNTANT,

15, UNION COURT, OLD BROAD STREET, E.C.

Secretary, Brighton Gaslight and Coke Company.
Auditor, West Surrey Water Company.

GAS COAL.

THE MIRFIELD COAL COMPANY are supplying GAS COAL of the best quality on trucks at their siding. This Coal contains 10 per cent. of Cannel, and, as analyzed by Mr. James Paterson, of Warrington, yields 12,600 *cubic feet of* 16·67 *candle gas, with* 1430 *lbs. of good Coke, per ton.* Ash in Coke, 1·88.

Apply to the MIRFIELD COLLIERY, Mirfield, NORMANTON.

NOTICE TO MANAGERS OF GAS COMPANIES.

THE LAW UNION FIRE AND LIFE INSURANCE COMPANY, of No. 126, Chancery Lane, London, grants Policies of Insurance on Gas-Works, and Buildings connected therewith, which cover risk of explosion and spontaneous ignition of Coal, on very advantageous terms. Full particulars will be sent post free on application to FRANK M'GEDY, Secretary.

126, Chancery Lane, London.

A PAMPHLET ON DIP-PIPES, &c., post free 6½d., on application to W. WHITE, Gas-Works, Abersychan, Mon. See Reviews in the *Gas Trade Circular and Review*, March 29, 1878, and *Design and Work*, March 30, 1878.

SILICATE PAINTS.

THE BEST & CHEAPEST For every purpose to which Paint is applied.

MANUFACTURED IN ALL COLOURS BY

THE SILICATE PAINT CO.,

LONDON— 107, CANNON STREET, E.C.

LIVERPOOL— SEEL STREET.

HARRIS'S PATENT SELF-ACTING

PRESSURE REDUCING VALVE,

Adopted by eminent Engineers for regulating Steam of High or Varying Pressure, so as to give off a supply at any desired uniform lower pressure. Of great value in Chemical Works and Gas-Works working up their Residuals.

TESTIMONIALS.

From Messrs. J. I. THORNYCROFT AND CO., Steam Yacht Builders, Chiswick.

The Pressure Reducing Valve working on our Steam Hammer has been working for some time, and to our satisfaction, giving off a pressure of 25 lbs. per inch; the boiler pressure being 90 lbs.

From HENRY MARTIN, Esq., C.E., Resident Engineer, Hanwell Asylum.

I have much pleasure in bearing testimony to the thorough efficiency of your Pressure Regulating Valve. I have one in use to reduce the pressure from 35 lbs. in a High-Pressure Boiler to 3 lbs. in a drying-room, and I am perfectly satisfied with the manner it always performs its duty, without the slightest trouble or attention. If of any advantage to you, the Valve can be seen in action by any person desiring it.

I shall be glad to receive the 3-inch one for water pressure as soon as possible.

From Messrs. T. TAIT AND SONS, Inverurie Mills, Inverurie.

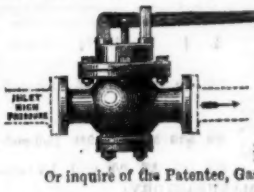
In reply to yours of the 25th inst., we are not in the habit of giving certificates, but if any one in this neighbourhood wishes to see the Valve, we shall be happy to show it.

From the SUPERINTENDENT, Derby County Asylum.

Your Pressure Regulating Valve or Apparatus answers remarkably well. We do not work at more than 20 lbs. pressure on the Boiler, but your Apparatus effectually reduces this to 2½ lbs. in the drying closets.

Prices as under for Reducing Higher Pressures to any Uniform Pressure under 10 or 15 lbs. per square inch.

1 in.	£2 10
1¼ ,,	3 15
2 ,,	4 10
3 ,,	7 0
4 ,,	9 10
6 ,,	14 0



Special Prices for Outlet Pressures of 25 lbs. to 50 lbs.

J. HARRIS, Engineer, Fairfield Rd., London

Or inquire of the Patentee, Gas-Works, Ross.

CATHELS'S Patent District Dry Gas-GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

For prices, &c., apply to the Manufacturers, Messrs GUEST AND CHRIMES, ROTHERHAM.

CATHELS & TERRACE'S Patent Four-WAY DISC GAS-VALVE is the simplest and best Valve for Purifiers, and as a By-pass for other apparatus in Gas-Works. It is always gas-tight, and has no springs, ground faces, or other delicate parts. By its use the flow of the gas cannot be accidentally stopped, and it never sticks.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, Foundry and Brass Works, ROTHERHAM.

CATHELS'S Improved Retort-Settings. Guaranteed to heat and wear well, with great economy of Fuel.

Coloured lithograph copies of Working Drawings of Beds of One to Seven Retorts (so clearly arranged and fully shown as to be easily understood by any retort setter or bricklayer) having been made of these valuable settings, they can now be supplied with detailed Specification immediately on receipt of orders.

Apply to Mr. THOS. NEWBIGGING, Consulting Gas Engineer, 5, Norfolk Street, MANCHESTER.

MANN & OWENS

PATENT SCREW & CAM GAS-VALVES.

SIZES from 2 In. to 48 In.

As supplied to
THE GASLIGHT & COKE CO., LONDON:
The CORPORATIONS of MANCHESTER, BIRMINGHAM, CARLISLE, OLDHAM, STOCKTON, HALIFAX, &c.
And to the following Companies—viz.:
PHŒNIX, SOUTH METROPOLITAN, BRENTFORD, WINDSOR ROYAL, IPSWICH, WEST HAM, BILSTON, ARUNDEL, DUDLEY, ST. HELEN'S, MORECOMBE, THRAPSTONE, &c.,
And to the various WORKS of the
BRITISH GASLIGHT COMPY.

Every Valve warranted perfectly Gas-tight.

SOLE MAKERS, S. OWENS & CO.,
ENGINEERS,
WHITEFRIARS STREET, LONDON.
PRICES ON APPLICATION.

GRIRDROD'S PATENT

PORTABLE PIPE SCREWING MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

W. H. BAILEY & CO.,

Brassfounders, Gauge njector and Tool Makers,
ALBION WORKS, SALFORD,
LANCASHIRE.

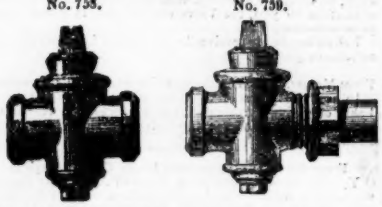
LAMBERT'S

CAST-IRON GAS-MAIN COCKS,

WITH PATENT WHITE METAL PLUGS.

TRADE (L) MARK.

No. 758. No. 759.



The bodies of these Taps are made of iron, black or galvanized, and the plugs of patent metal. They are warranted not to set fast or corrode, as do Iron or Brass Cocks; will always work easily; are strong, well made, durable; of little or no intrinsic value, and therefore not likely to be stolen; and the prices as stated below are (especially upon the larger sizes) fully 50 per cent. less than Brass Cocks.

	¾	1	1¼	1½	2-inch.
No. 758, with inside screws for iron pipe, black . . .	2/0	3/0	4/4	6/6	7/6	12/0 each.
No. 759, with union on one end screwed inside for iron pipe, black . . .	2/9	3/10	5/4	8/0	9/0	15/0 each.
Nos. 758 and 759, galvanized	0/3	0/4	0/6	0/8	0/10	1/4 extra.

MANUFACTORY:
SHORT STREET, LAMBETH, LONDON.

GREAT SAVING OF LABOUR.
ENOCH'S PATENT
PORTABLE DRILLING-MACHINE,

Now in use by all the Principal Gas and Water Companies in the United Kingdom.

E Size, for Services in Pipes, 2 to 3 in. bore	£3 10 0
F Size, for Services in Pipes, 2 to 4 in. bore	4 0 0
G Size, for Services in Pipes, 2 to 6 in. bore, with Telescope Cramp.	4 10 0

Drills, 1s. 6d. each.

Machines sent on approval, if desired.

Prices for other Sizes and Modifications, with full Particulars and Testimonials, on application to

ALEXANDER ANDERSON,

Office: 9, London Street, E.C. Warehouse: Vine Street, Minories, London, E.

GAS PURIFICATION.

BAILES & HALLSWORTH,
CONTRACTORS FOR THE
PURIFICATION OF COAL GAS
BY THEIR
PATENT HYDRATED PEROXIDE OF IRON MATERIAL.

The Material is adapted specially for taking up sulphuretted hydrogen, and will simultaneously absorb any ammonia that may pass the scrubbers.

The spent oxide resulting from our Material is more valuable than that from natural oxide of iron, and manufacturing chemists buy it in preference.

The Material has now been in use during the past three years in most of the principal Gas-Works in Yorkshire and elsewhere.

It contains considerably less moisture than natural oxide of iron, and is much cheaper and more efficient as a purifying agent.

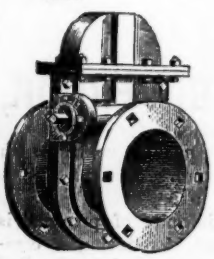
B. & H. are purchasers of Spent Oxide, or will take Spent in exchange for New Material.

FOR SAMPLES AND TERMS, ADDRESS—

BAILES & HALLSWORTH, COPPERAS WORKS, ARMLEY. LEEDS.

B. DONKIN & CO.'S
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS.

TRADE MARK.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are proved on both sides to 30 lbs. on the square inch before leaving the works, and are kept in stock.

ALSO SOLE MAKERS OF
J. BEALE'S NEW PATENT GAS EXHAUSTERS,
AND MAKERS OF
STEAM ENGINES FOR DRIVING GAS EXHAUSTERS,
VALVES FOR AMMONIACAL LIQUOR,
IMPROVED BRIDGE VALVES FOR REGULATING THE SEAL IN HYDRAULIC MAINS,
BYE-PASS VALVES, SCREW WATER-VALVES.

B. DONKIN & CO., 55a, BLUE ANCHOR ROAD, BERMONDSEY, LONDON, S.E.

TO GAS COMPANIES AND THE TRADE.
J. DEFRIES & SONS,
MANUFACTURERS OF
CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS VESTIBULE LAMPS, AND THE PATENT CRYSTAL ILLUMINATION.
A LARGE STOCK ALWAYS IN HAND OF
IRON, BRASS, COMPOSITE, AND LEAD TUBES, FOR GAS AND WATER,
AND EVERY DESCRIPTION OF
GAS AND WATER FITTINGS.
THE PATENT DRY AND WET METER, WITH THE LATEST IMPROVEMENTS.
STREET LAMPS AND COLUMNS IN GREAT VARIETY.
WORKS: LONDON AND BIRMINGHAM.

GAS MOONS,
Cut and Engraved, of the newest designs

GAS REFLECTORS
In Silver and Glass

GAS NIBS
AND
BURNERS
Of every description.

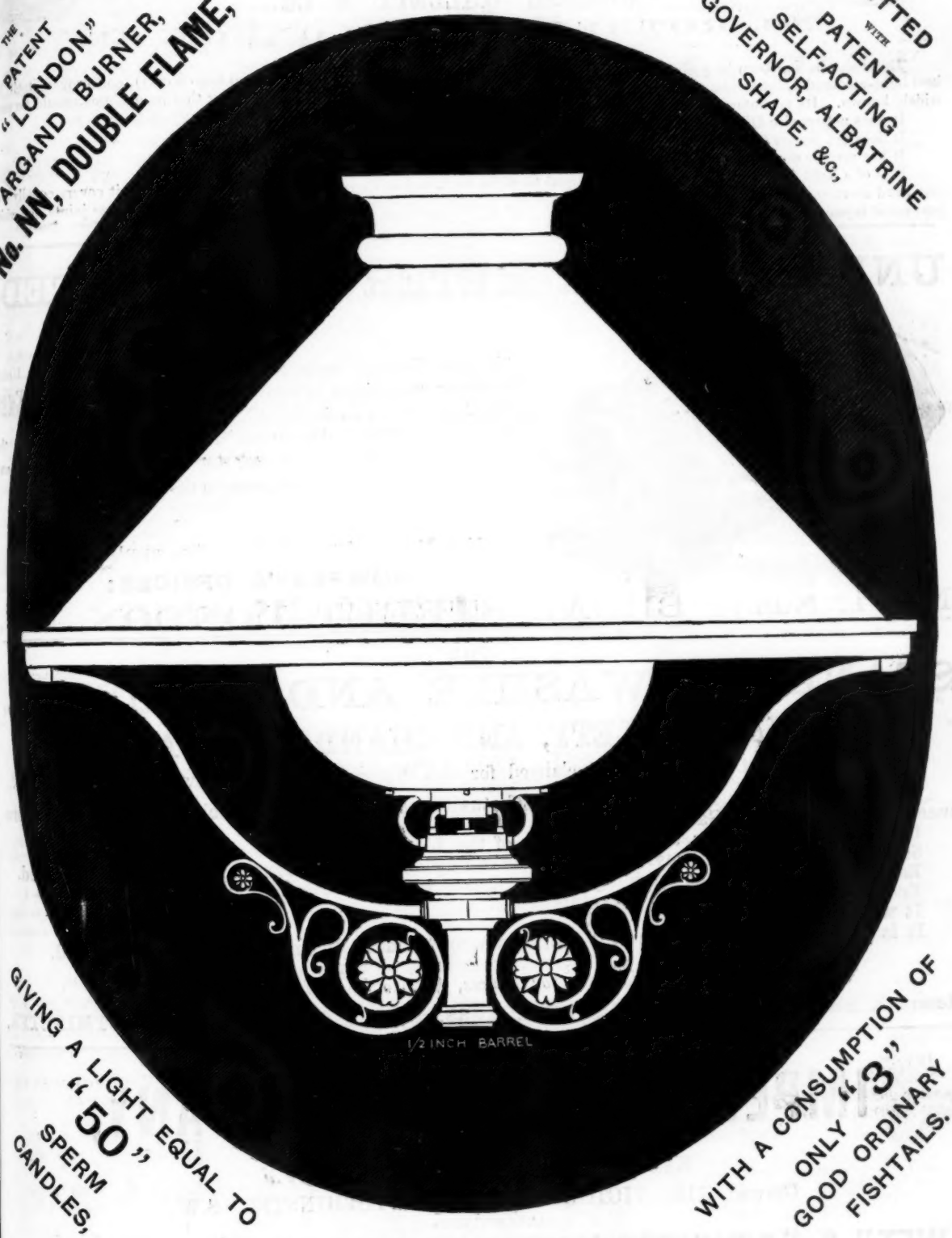
Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1878, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.
ESTABLISHED 1830.

POWERFUL LIGHT CENTRE.

THE PATENT "LONDON" ARGAND BURNER, No. NN, DOUBLE FLAME,

FITTED WITH PATENT SELF-ACTING GOVERNOR, ALBATRINE SHADE, &c.,



GIVING A LIGHT EQUAL TO "50" SPERM CANDLES,

WITH A CONSUMPTION OF ONLY "3" GOOD ORDINARY FISHTAILS.

NEAREST APPROACH TO DAYLIGHT.

WILLIAM SUGG,

GAS ENGINEER,

VINCENT WORKS, WESTMINSTER, S.W.

HALLETT'S
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,
296, ROTHERHITHE, LONDON, S.E.

This Paint having been in general use over sixteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known. Its advantages are that—

It does not require DRIERS like other Paints.

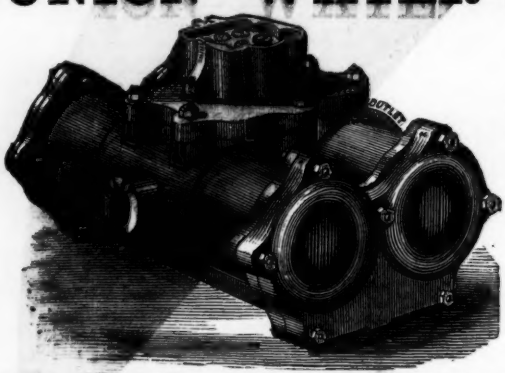
It does not poison the painter like white lead. No colic by its use.

It has greater durability in colour, as sulphurous gases do not blacken it as they do white lead.

It is of a light stone colour, and has a body equal to white lead, and as its specific gravity is so much less, it covers equally well one-third more surface, by which a great saving is effected; a similar economy arises from its use in steam and gas joints, for which purpose it is superior to white lead.

THE

UNION WATER-METER CO., LIMITED.



The above Company, having purchased the patent rights of the Union Water-Meter, are prepared to receive and execute orders for their Patent Positive Meters, which are simple and compact.

Upwards of 20,000 of these Meters are in successful operation in the principal cities of the United States, and have also been tested and approved by some of the leading Engineers in this country.

For Prospectuses, Prices, &c., apply to the

COMPANY'S OFFICES:

No. 4, NEW BROAD STREET, LONDON, E.C.

THE

STANDARD WASHER AND SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]

Some of the advantages claimed for this Apparatus are as follow:—

The Exposing of a large Amount of Effectually-wetted Surface (which is continually reproduced) to act upon the Gas.

Unerring Regularity in the Distribution of the Liquor.

Saving of Expense in Providing and Exchanging Scrubbing Material—none being required.

Economy of Space, thus enabling the Apparatus to be protected from the Weather.

Economy of First Cost and of Maintenance.

It works without Pressure.

It is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured.

Applications for Prices, &c., to be made to

Messrs. KIRKHAM & HERSEY, GAS ENGINEERS, 21, ABINGDON STREET, WESTMINSTER.

THE

IMPERIAL METER COMPANY,

LIMITED,

KING'S ROAD, LONDON, N.W.,

OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

Attention is called to their Dry Meters in Wood Cases, as used by the principal London Gas Companies. These Meters are especially suitable for seaport towns and for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

NOTICE.

THE GAS & WATER COMPANIES DIRECTORY, 1878.

(WATER SECTION.)

The Editor will feel greatly obliged if Secretaries and Engineers would fill up, and return to him at once, the forms sent them, as the work is now going to press. If any have not received Forms, they will be forwarded immediately, on application to the Editor,

CHARLES W. HASTINGS,

8, BUCKINGHAM STREET, ADELPHI, LONDON, W.C.

JAMES MILNE & SON,

GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

EDINBURGH, AND

2, KING EDWARD STREET,

NEWGATE STREET, LONDON.

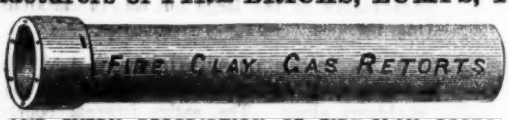
Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,



AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

GEORGE ANDERSON,

GAS AND CONSULTING ENGINEER,

35A, GREAT GEORGE STREET,

WESTMINSTER, S.W.,

PATENTEE and MANUFACTURER of the following Invention

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

PRICES AND ALL PARTICULARS TO BE HAD OF THE PATENTEE,

35a, GREAT GEORGE STREET, WESTMINSTER, S.W.

CANNEL COAL.

ELLIS LEVER & CO., Central Coal Offices, 46, Cannon Street, London, E.C., and 6, Piccadilly, Manchester, are prepared to contract for the supply of THE BEST CLASSES of CANNEL and GAS COAL, for long or short periods. Analysis and prices on application.

ELLIS LEVER & CO.,

CANNEL AND GAS COAL CONTRACTORS,

Shippers of Steam and House Coal

AT ALL

ENGLISH, SCOTCH, AND WELSH PORTS.

46, CANNON STREET, LONDON,

AND

6, PICCADILLY, MANCHESTER.

ALFRED LASS,

SPECIAL ACCOUNTANT FOR GAS COMPANIES,

30, GRACECHURCH STREET, LONDON.

Accounts analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.

The Forms of Account, which have been specially designed by A. L. to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.

The above forms are registered.

Water Companies Accounts also prepared and adjusted.

CONSULTATIONS.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

MR. EDWARD SANDELL,

Associate of the Society of Accountants in England, Publisher of the "Gas Companies Expenditure Journal,"

Begs to announce his REMOVAL from Skinner's Place, Size Lane, to

No. 2, ST. GEORGE STREET, WESTMINSTER.

Mr. ROBERT DEMPSTER, Sen.,

CONSULTING GAS ENGINEER,

Of Messrs. Robert Dempster and Sons, Rose Mount Gas Engineering Works,

ELLAND, near HALIFAX,

May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Our R. D., Sen., having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations, is both extensive and reliable.

REMOVAL.

CHARLES HEISCH, F.C.S., Analytical and Consulting Chemist, Superintending Gas Examiner to the Corporation of London, &c., &c., has REMOVED from 8, Savage Gardens, to 79, MARK LANE, where he may be consulted as usual.

JOHN ROMANS, C.E., F.G.S.E.,

CONSULTING GAS ENGINEER

AND

CANNEL COAL FACTOR,

30, St. Andrew Square, EDINBURGH.

Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

GAS-WORKS TAKEN ON LEASE.

Mr. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

ANALYSIS AND PRICES FORWARDED ON APPLICATION.

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c.,

SCOTSWOOD FIRE-BRICK WORKS, SCOTSWOOD-ON-TYNE.

Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

BIRTLEY IRON WORKS,

CHESTER-LE-STREET,

DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. MANWARING, 101 Cannon Street, E.C.

BOUCK & CO., LIMITED,

TAR DISTILLERS & MANUFACTURING CHEMISTS,

MILES PLATTING, MANCHESTER.

BRANCH WORKS, BLACKBURN.

BUYERS OF COAL TAR,

And Crude Products therefrom,

AMMONIACAL LIQUOR, &c.

JOHN SPENCER,

VULCAN WORKS, WEST BROMWICH, & 97, CANNON ST., LONDON,

Manufacturer of Every Description of

TUBES & FITTINGS,

Plant, Tools, Stores, and all requisites for Gas and Water Works: Gasholders, Purifiers, Scrubbers, Roofing, Sashes, Retort Fittings, Grids, Socket-Pipes, Lamp-Posts, Wheelbarrows; Brasswork, Chandeliers, and Gas-Fitters Tools; Liquor-Pumps, Valves; Clay Retorts and Fire Goods, &c.

YEO'S PATENT ENGINE PACKING,

Price 1s. 8d. per lb., any size.

Tarred & White Spun Yarn for Pipe Joints, at various prices.

Samples and testimonials free per post.

E. YEO, NEWTON ABBOT.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

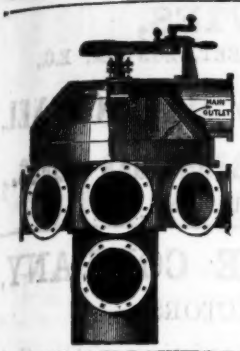
Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

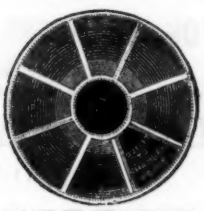
They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

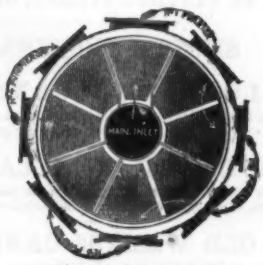


ELEVATION OF THE CENTRE-VALVE.

C. & W. WALKERS'
PATENT CENTRE-VALVES.



PLAN OF THE VALVE.



PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD,

MANUFACTURERS OF

RETORTS, ANNULAR AND PIPE CONDENSERS,

WROUGHT AND CAST IRON SCRUBBERS, PURIFIERS, GASHOLDERS,

GOVERNORS, AND ALL THE NECESSARY FITTINGS FOR COMPLETING THE ERECTION OF GAS-WORKS.

STATION & CONSUMERS WET OR DRY METERS, STREET & SERVICE MAINS, LAMP COLUMNS & BRACKETS, & WROUGHT-IRON TUBES AND FITTINGS; WROUGHT-IRON ROOFS FOR ANY SIZE OF BUILDINGS.

Sole Makers of B. W. Thurston's Combined Condensing, Scrubbing, and Washing Apparatus,

AND PATENTEES OF THE IMPROVED COMBINED CONDENSING AND PURIFYING APPARATUS SO EMINENTLY ADAPTED FOR EXPORTATION.

REFERENCES TO UPWARDS OF 300 GAS-WORKS.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS.

And all kinds of Experimental Gas Apparatus.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD,

MANUFACTURERS OF

IMPROVED CENTRE-VALVES,

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

198, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 16-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 13½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,524 cubic feet per ton of 14½-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonized were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

PRICES ON APPLICATION, EITHER F.O.B. OR BY RAIL IN TRUCK LOADS.

THE TYNE COAL COMPANY, LIMITED, OWNERS.
W. RICHARDSON, Fitter,
29, QUAYSIDE, NEWCASTLE-ON-TYNE.

FERRAND DAVIES,

148, GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.,

AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL,

AND

NEWTON, CHAMBERS, & CO.'S SILKSTONE GAS COALS.

Analyses and Quotations on application.

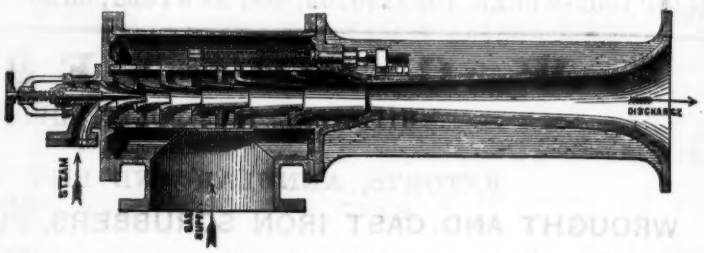
MIDLAND & YORKSHIRE COMPANY,

COAL OWNERS AND FACTORS,

Supply to any Railway Station the best descriptions of Gas Coal, Nuts, and Cannel.

PRICES ON APPLICATION.

HEAD OFFICE: 79, MARK LANE, LONDON.



KÖRTING'S STEAM-JET GAS-EXHAUSTER.

IMPROVED CLELAND'S PATENT.

UPWARDS OF 250 IN USE.

CLELAND'S PATENT CONDENSER AND STEAM SCRUBBER.

FOR PARTICULARS, APPLY TO

KÖRTING BROS.,

17, LANCASTER AVENUE, MANCHESTER,

OR TO

GERALD J. TUPP, 8, John Street, Adelphi, W.C., LONDON,

SOLE AGENT FOR ENGLAND AND WALES.

THE WIGAN COAL & IRON COMPANY,

LIMITED.

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

ALBERT GAS COAL.

THE DERBYSHIRE SILKSTONE COAL COMPANY,

LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered in trucks at any Railway Station in England, or shipped on board at Hull, Grimsby Docks, or Barrow-in-Furness.

Purified gas per ton of coal in cubic feet (average)	10,775
Illuminating power in candles	14·71
Weight of coke in lbs. per ton of coal	1,502

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

HYDRATED PURIFYING MATERIAL.

Samples on application.

MESSRS. SPENCE BROS., LIMITED,

Will be glad to supply the above on the most favourable terms,

And to treat, by Purchase or Exchange, for Spent Oxide.

PRICES ON APPLICATION.

ALSO PATENT DRY COPPERAS FOR EXTRACTING AMMONIA.

VICTORIA CHEMICAL WORKS, BRADFORD, NEAR MANCHESTER.

Established

1795.

JOSEPH CLIFF & SONS,

THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

London Wharf: No. 4, inside Great Northern Goods Station, King's Cross, N.;

LIVERPOOL: Back Leeds Street.

SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 1000 days, and are yet in good order. References on application.

July 2, 1877.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"*Warrington Gaslight and Coke Company,*
Offices, Mersey Street, Warrington, April 23, 1877.

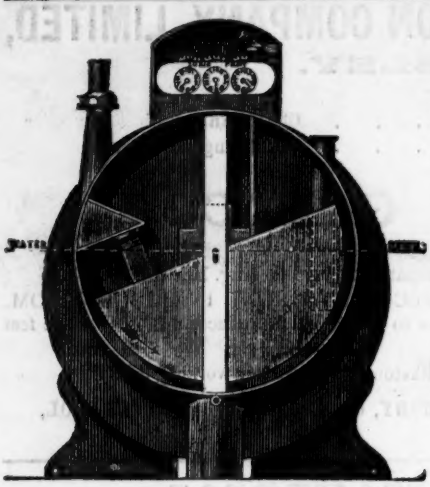
"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.



THE

UNVARYING WATER-LINE GAS-METER,

(SANDERS AND DONOVAN'S PATENT.)

"Unquestionably the best Water Gas-Meter now in use."—Thos. G. Barlow, C.E.

Over 120,000 in action.

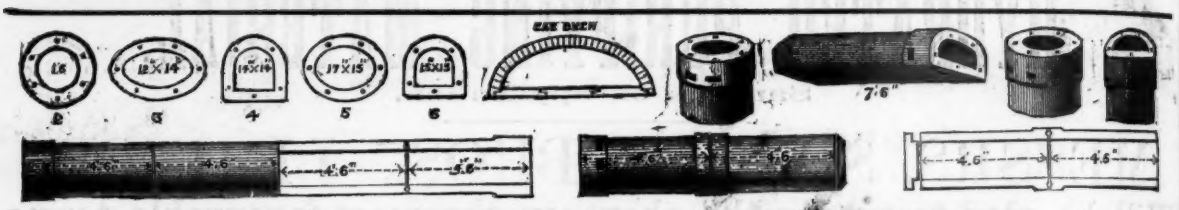
MANUFACTURERS:

THE GAS-METER COMPANY, LIMITED,

KINGSLAND ROAD, LONDON;

WITH

Branch Manufactories at DUBLIN and OLDHAM.



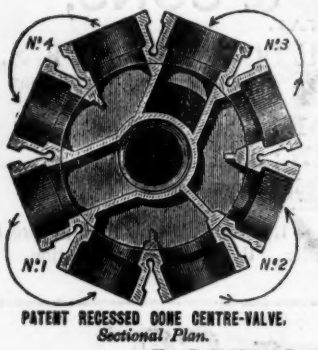
HARRIS & PEARSON, STOURBRIDGE,

Proprietors of Best Clay Mines. Largest makers in the World of Gas-Retorts, Lumps, Tiles, Fire-Bricks, and Fire-Clay Goods of all kinds. Large Stock of Retorts always on hand. Orders for any Size executed on receipt.

CAST-IRON GAS AND WATER PIPES,

WROUGHT IRON AND LEAD TUBING, GLAZED DRAIN-PIPES,

STAFFORDSHIRE BLUE BRICKS.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.

R. LAIDLAW AND SON,

EDINBURGH AND GLASGOW,

SOLE MAKERS OF

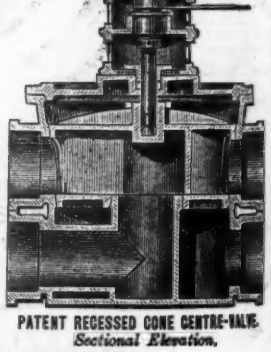
PATENT

RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

LONDON OFFICE: 106, CANNON STREET.

D. HULETT & CO.

Invite the attention of Gas Companies, Corporations, and others to their

PATENT STREET LAMPS,

Which are so constructed that neither putty nor other materials are required to secure the glass. No hacking out of old putty, which frequently destroys the frames. A new pane of glass can be inserted in two or three minutes by any inexperienced person, the glass being secured by a hinged flap and turn button.

PRICE 10s. each, net. Special quotations for large quantities.
Also made EXTRA STOUT recommended for its durability, PRICE 11s. 6d. each.

D. HULETT'S IMPROVED SERVICE CLEANSER,

By the use of which stoppages in service and other pipes are freed from naphthaline and other obstructions in a few minutes. PRICE 73s. net.

HULETT'S PATENT MERCURIAL REGULATOR,

For inserting in mains, to prevent the excess of pressure in high ground, or other elevated positions.

PATENTEES OF IMPROVED WET AND DRY GAS-METERS.

Makers of all kinds of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

GAS HEATING AND COOKING STOVES.

55 and 56, HIGH HOLBORN, LONDON.

London: Printed by William Boughton King (at the office of Clayton and Co. 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, May 21, 1878.